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Flood Planning and Response Guide for British Columbia

Water Management Branch

Provincial Emergency Program

March 1999

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Preface

This Flood Planning and Response Guide has been developed to assist Local Authorities and Diking Authorities prepare a flood response plan to guide activities during flood events. Local Authority and Ministry of Environment, Lands and Parks representatives from the southern half of the province who had participated in recent flood response activities were interviewed by the consultant. Local Authority and Diking Authority respondents and senior governments also participated in a workshop held February 18, 1999 in Chilliwack BC. The reviewers and workshop participants are listed in the Acknowledgements.

Local Authorities are required to prepare a local emergency plan under the *BC Emergency Program Act*, and that plan should include a flood response component if the Local Authority area is subject to flooding. Diking Authorities should prepare a flood response plan as they are in the best position to provide initial response efforts when a flood occurs.

This guide consists of two parts:

PART 1 - FLOOD PLANNING describes the process for a Local Authority or Diking Authority to develop a flood response plan, and provides information regarding the preparation of the plan. This follows the process for developing a local emergency response plan as outlined in the *Local Authority Planning Guide (1996 Revision)* prepared by the Provincial Emergency Program (PEP).

PART 2 - FLOOD RESPONSE includes a template that may be used to prepare the flood response plan, and other flood response-related information. The template facilitates the completion of the plan by enabling the Local Authority or Diking Authority to "fill in the blanks" with regards to the particular local conditions and circumstances. The flood response-related information can be included in the plan as appropriate.

This guide is intended to promote advance planning, share available information and lead the reader to further flood planning and response practices.

The guide is necessarily generalized and the applicability of the apporaches discussed need to be evaluated and applied on a site specific basis.

Steps in Preparing and Implementing a Local Flood Response Plan

STEPS	GUIDE REFERENCE
Preparing the Flood Response Plan	
• Gather the information	Part 1 - Section 3.2.2
• Develop the organization	Part 1 - Section 3.2.3
• Prepare the plan	Part 1 - Section 3.2.3 Part 2 - The Template Part 2 - Flood Response Information
• Distribute, train, educate and review	Part 1 - Section 3.2.4
Implementing the Plan	
• Pre-flood phases	Part 1 - Section 3.3.1
• Flood phases	Part 1 - Section 3.3.2
• Environmental considerations	Part 1 - Section 3.3.3
Post Flood Management	
• Recovering from a flood	Part 1 - Section 3.4.1
• Debriefing	Part 1 - Section 3.4.2
Annual Flood Plan Review and Update	
• Review after an event	Part 1 - Section 3.4.2
• Annual review	Part 2 - The Template

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1. Introduction

1.1 Purpose of this Guide

"Within this province, over the past century, more property damage has been inflicted by various forms of flooding than by any other natural hazard." *Natural Hazards in British Columbia, 1996*

The purpose of this guide is to assist Local Authorities and Diking Authorities in British Columbia appropriately plan and respond to floods, by preparing a flood response plan. As such it provides information on a wide variety of topics related to flood planning and response, and provides references to additional information. This guide is not a replacement for a flood response plan, but will assist Local Authorities and Diking Authorities in preparing their flood response plan.

Local Authorities refer to all municipalities and some regional districts and national parks as defined in the *BC Emergency Program Act.* Diking Authorities refer to diking authorities and diking districts regulated under the *BC Dike Maintenance Act.* Refer to Appendix A for further clarification.

1.2 Flood Response Planning

"Beyond the human toll taken in lives and suffering, flood damage costs Canadian taxpayers millions of dollars annually." *Emergency Preparedness Canada and Canadian Mortgage and Housing Corporation (1998)*

Flood response planning is a strategy to minimize loss of life, injury and trauma and to reduce property damage as a result of a flood. A well thought out and documented flood response plan will help Local Authorities and Diking Authorities anticipate flood-related problems and possible solutions. No one can anticipate every contingency during a flood event, but a flood response plan will help develop appropriate responses for a wide range of occurrences. A flood response plan will enable quicker, more effective and more efficient response, and lead to a speedier recovery.

Depending on the size and geographic complexity of the local area over which the Local Authority or Diking Authority has jurisdiction, the flood response plan document can range from just a few pages to several binders, and from simple to complex. The flood response plan should be designed to suit the local conditions and the local situation.

1.3 Local Authorities, Diking Authorities and Flood Response Planning

Local Authorities, under the *BC Emergency Program Act*, must have a local emergency plan, and provide initial response. Flooding is an important type of emergency which should be a common component of the local emergency plan.

Floods, of one kind or another, can affect almost all parts of British Columbia, and therefore all Local Authorities and Diking Authorities should have a flood response plan. Time and time again, it has been shown that small jurisdictional areas are usually at a greater risk from floods because they typically have fewer resources than larger areas.

The appropriate and legal roles and responsibilities of all concerned parties during a flood are summarized in Appendix A. The *Local Authority Planning Guide (1996 Revision)*, prepared by the Provincial Emergency Program of the BC Ministry of Attorney General should assist Local Authorities in preparing their local emergency plans.

1.4 Organization of this Guide

Diking Authorities, under the *BC Dike Maintenance Act*, must have an emergency response plan. Dike owners are in the best position to anticipate and provide the first response to a flood.

This guide has been prepared to assist Local Authorities and Diking Authorities plan and respond to floods.

PART 1, Section 2 introduces the topic of floods, provides some information on how floods fit into the broader category of natural hazards and water-related hazards, briefly explains the diversity of flood types in the province, and briefly describes some notable floods in British Columbia's history.

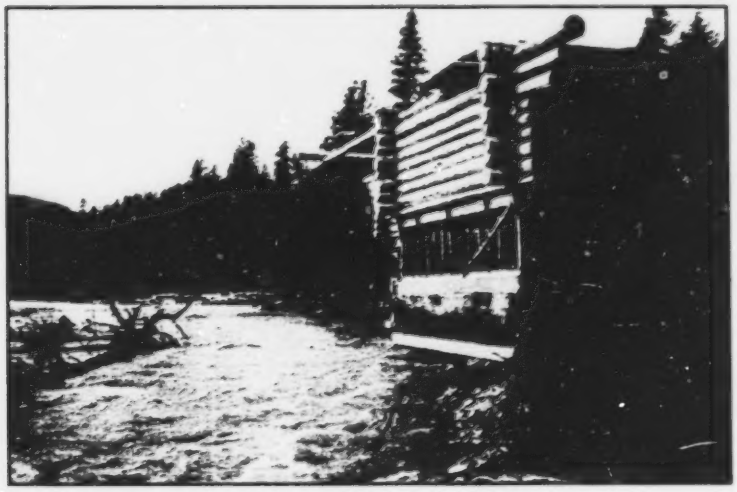
PART 1, Section 3 describes in detail, four aspects of flood planning and response:

- flood prevention and flood damage prevention;
- preparing a flood response plan;
- implementing a flood response plan; and
- post flood management.

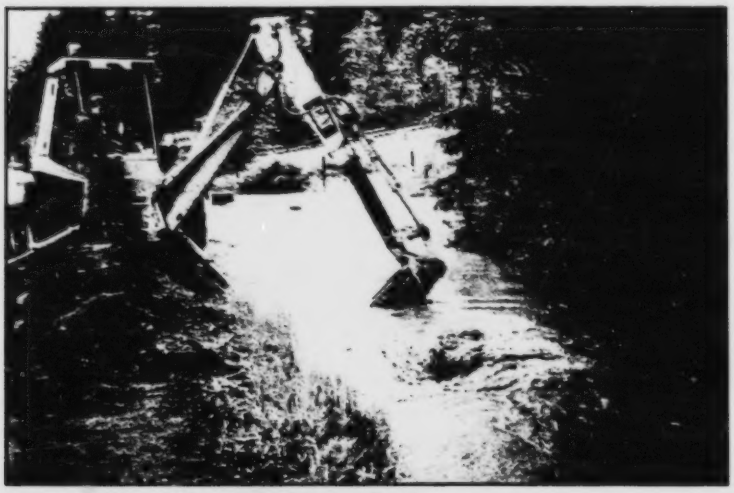
These aspects relate to the four phases of emergency management: prevention, preparedness, response and recovery.

From the information in PART 1, Section 3, and additional information found in PART 2 - FLOOD RESPONSE, the Local Authority or Diking Authority should be able to prepare a flood response plan.

PART 1, Section 4 provides sources of additional information, including printed material and Internet web sites.



Erosion resulting from a freshet flood



Clearing Culvert inlet at Coldstream Creek

Debris flow at Hummingbird Creek

2. Floods

2.1 Floods: one of many natural hazards in British Columbia

Floods can result from a wide range of conditions, processes and situations associated with climate, geomorphology and human activity. For the most part, floods are natural events, however, humans are having an increasing role in their occurrence.

A flood is any body of water that overtops its natural or artificial boundaries and inundates land not normally under water.

Only when floods affect people or property, or detrimentally affect the environment, are they considered as hazards. The effects of a flood are many and diverse, and go well beyond the area actually flooded. For example, costs directly related to the flood response and recovery are not only borne by those living in the flooded areas, but also by others in the vicinity, the region, the province and, in some cases, the country. Indirect effects can include potential economic losses for the area, for example, businesses relocating or a decrease in tourism, and psychological effects on residents due to uncertainty regarding their safety.

As one might expect in a province as large and as diverse as British Columbia, there are a wide variety of natural hazards. Some, such as major earthquakes and volcanoes, occur infrequently but can have a large effect. Others, such as landslides, snow avalanches and numerous water-related hazards, occur more frequently but have a relatively smaller effect than earthquakes and volcanoes.

Natural Hazards in British Columbia

earthquakes
volcanoes
landslides
subsidence
snow avalanches
water-related hazards

adapted from Natural Hazards in British Columbia, 1996

Water-Related Hazards in British Columbia

dam failures
debris avalanches
debris flows
erosion and accretion
submarine landslides
floods
ice jams
landslides
tsunamis

adapted from BC Emergency Program Act

Floods fall into the category of relatively frequent water-related hazards. To put floods in perspective, "within this province, over the past century, more property damage has been inflicted by various forms of flooding than by any other natural hazard" (*Natural Hazards in British Columbia, 1996*).

One reason for this is that floods are associated with most of the other types of water-related hazards and non-water-related hazards, including earthquakes, landslides, snow avalanches, dam failures and ice jams. Another reason is that British Columbians tend to live in the relatively flatter, low-lying areas of this mountainous province, and these areas are potentially prone to many different types of flooding.

2.2 Types of Floods in British Columbia

A number of different type of floods are common in British Columbia. Among the more common types are:

flash floods — are associated with intense rainfall or rain on snow events, and therefore usually occur very suddenly with little warning.

freshet floods — generally occur as a result of snowmelt, and therefore usually occur in the spring or during warm periods during the winter and are usually more predictable.

ice jam-related floods — occur when the normal flow of water in a stream or river is impeded by ice, and therefore usually occur in the spring or during warm periods during the winter, with very little warning.

debris flow-related floods — (also referred to as debris torrents or mudflows) involve sediment and organic material being transported with water down steep mountain streams. They can occur as a result of high runoff and therefore may occur during periods of rainfall or warm winter periods with little or no warning.

blockage-related floods — can occur as a result of a landslide blocking a stream or river, a landslide (or snow avalanche) changing the course of a stream or river, or a large landslide failing into a large body of water, and can occur at any time of the year, with very little warning.

storm surge floods — are usually the result of a combination of extreme tides and high winds, or a storm with excessive winds, and are most common during the winter, with limited warning available.

tsunamis — are the result of an earthquake or submarine landslides, and although this type of flood can occur at any time of the year with very little warning, special geographic conditions are usually necessary.

Flood Planning and Response Tips for each of these types of floods are summarized in PART 1, Appendix B.

Minor and major floods are not types of floods, but describe the relative severity of floods. These terms are used by the Provincial Emergency Program and other provincial government agencies, and are described more fully in PART 1, Appendix A and the *BC Flood Plan, April 1998*, which is updated annually.

Conditions that can lead to flooding are numerous. Sometimes they act alone; sometimes in combination with one another. They can be subdivided into groups on the basis of climatic conditions, geomorphic processes and human/animal-related situations.

Conditions Conducive to Flooding

Climatic conditions:

- intense rainfall event (a large amount of rainfall over a short period of time)
- moderate rainfall event over a long period of time
- snowmelt conditions
- rainfall event on snow or snowpack (accelerates snowmelt)
- ice damming (jamming) of a stream or river
- storm with excessive wind (storm surges)
- high tide combined with wind and low barometric pressure

Geomorphic processes:

- landslide damming of a stream or river
- landslide or snow avalanche changing the course of a stream (avulsion)
- high stream or river discharge changing the course of the stream or river (avulsion)
- debris flow and/or log jams
- earthquake causing a tsunami
- submarine landslide causing a tsunami
- large wave generated by a landslide into a body of water

Human/animal-related situations:

- activities in watersheds (e.g. logging, change of drainage patterns)
- changes in releases from upstream dams
- dike failure
- dam failure
- other human activity
- animal activity (e.g. beaver)

Geographically, most flooding occurs in four areas:

- in low lying, valley bottom areas often associated with lakes or large and/ or meandering rivers;
- along streams, rivers and lakes;
- on active alluvial or colluvial fans; and
- along the coast (areas influenced by tides).

The following table summarizes the likelihood of the four different geographical areas being affected by flooding resulting from climatic conditions, geomorphic processes and human/animal-related situations.

It should be noted that there can always be exceptions to the generalizations in this table.

Likelihood of Flooding

	Low lying, valley bottom areas	Along streams, rivers and lakes	Active alluvial or colluvial fans	Along the coast (tidal areas)
Climatic conditions				
intense rainfall	High	High	High	Low
moderate rainfall over a long period of time	High	High	High	Low
snowmelt	High	High	High	Low
rainfall on snow or snowpack	High	High	High	Low
ice damming (jamming) of a stream or river	Moderate	High	Low	None
storm with excessive wind	High	Low	Low	High
extreme tide combined with wind	None	None	None	High

Likelihood of Flooding

Geomorphic processes	Low lying, valley bottom areas	Along streams, rivers and lakes	Active alluvial or colluvial fans	Along the coast (tidal areas)
landslide damming of a stream or river	Moderate	High	High	None
landslide or snow avalanche changing the course of a stream	Low	High	High	None
high stream or river discharge changing the course of a stream or river	Low	High	High	None
earthquake causing a tsunami	Low	None	None	High
submarine landslide causing a tsunami	Low	None	None	High
large wave generated by a landslide into a body of water	High	Low	None	High
Human/animal-related situations				
dike failure	High	High	High	High
dam failure	High	High	High	Low
human activity	Low	Moderate	High	Low
animal activity	Low	High	Moderate	Low

2.3 Some notable floods in British Columbia's history

Flash Flood

Intense precipitation combined with melting snow in June 1995 caused record flood flows in the Elk River valley in Southeast BC. The storm flows resulted in flooding and a breach of the Coal Creek training berm at Fernie, the washout of several kilometres of roads, the collapse of several highway and railway bridges over Michel Creek, exposure of several sections of gas pipeline, and a near failure of the Michel Creek Mountain Mobile Home Park dike at Sparwood.

Freshet Flood

The greatest BC flood on record occurred in 1894 and affected extensive areas in the southern half of the province, including Prince George to Quesnel, Kamloops, Mission and throughout the Lower Fraser Valley. During the 1948 Fraser River Flood, several people died, 2000 houses were destroyed, 16,000 residents were evacuated, 22,000 ha of land were flooded, and both the Canadian National and CP railways, and the Trans-Canada Highway were severed. Based on the 1894 flood, an estimated $1.8 billion in flood related damages could be expected today, if an 1894 event occurred and caused dike failure. (Adapted from *Review of the Fraser River Flood Control Program, Task Force Report to the Fraser Basin Management Board, May 1994*)

Ice Jam-Related

In January 1984, the Nicola River and its two tributaries, near Merritt, broke up suddenly due to a sharp increase in discharge from rain-on-melting snow event while the ice cover was still thick. The resulting ice run and jam caused hundreds of thousands of dollars in damage to public and private property, including the destruction of a bridge. Damage was due to either the severe ice run within the channel, or to water forced out over the floodplain by ice jams.

Tsunami

The Alaska earthquake of March 1964 triggered a tsunami that killed 130 people between Alaska and California. In British Columbia, Port Alberni was the hardest hit community, although Hot Springs Cove and Zeballos also suffered significant wave and flood damage. The tsunami grew as it crossed Barkley Sound and moved up the Alberni Inlet. Three waves hit Port Alberni, the largest was 7 m high, and was estimated to be moving at 50 kph. As a result 260 homes were damaged, 60 extensively, and total damage ranged between $5 and $10 million.

Tsunami damage in Port Alberni - 1964

3. Flood Planning and Response

Planning and response for floods, as for any emergency, can be divided into several phases:

- flood prevention and flood damage prevention;
- preparing a flood response plan;
- implementing the flood response plan; and
- post flood management.

Local Authorities and Diking Authorities who follow these phases should be ready to react effectively and efficiently when a flood situation arises. This will minimize loss of life, injury and trauma, reduce property damage and result in a speedier recovery from the flood. The roles and responsibilities of individuals and governments are described in Part 1, Appendix A.

To paraphrase an old saying, an ounce of planning is worth a pound of response.

3.1 Flood Prevention and Flood Damage Prevention

In most cases, the occurrence of a flood resulting from a climatic condition or a geomorphic process cannot be prevented. In some instances, however, especially when humans are in-part the cause, floods can be prevented. Flood damage prevention measures are designed, not to stop floods from occurring, but to prevent, or at least reduce the consequences.

Nature to be commanded must be obeyed. (from Sir Francis Bacon, *"Novum Organum"* 1620)

Passive measures are those that don't involve any actual construction. Examples include:

- **land use restrictions, zoning and by-laws**, for example by zoning where, on a floodplain, individuals can, and cannot, build;
- **protection of wetlands and riparian areas**, for example by leaving the area adjacent to watercourses in the natural state;
- **building codes and building use regulations**, for example by requiring flood proofing of new or existing buildings;
- **tax and insurance incentives and disincentives**, for example by encouraging individuals to build in safe areas;
- **recovery incentives and disincentives**, for example by limiting assistance for new buildings which do not meet floodproofing standards;
- **flood forecasting**, to provide advance warning of possible flooding events; and
- **in-house and public education**, for example by training staff what to do when a flood is imminent, and educating the public about flood damage prevention.

Except for flood-forecasting and education, passive measures generally require both the necessary legislation and enforcement. The former, without the latter, does not work.

Active measures are those that usually involve construction or some from of action. Examples include:

- **diking or other flood protection works**, for example dams, storage reservoirs, diversions, channel modifications, erosion protection;
- **flood proofing methods**, for example raising structures; and
- **removal of rubbish from streams and drainage ditches**, for example shopping carts, tires, and brush cuttings.

Active measures require appropriate design, construction, inspection and maintenance.

Regardless of whether preventative measures are in place and/or carried out, a flood response plan should form a component of a Local Authority emergency plan, and is standard management practice for Diking Authorities.

3.2 Preparing a Flood Response Plan

The flood response plan should be prepared well in advance of any possibility of a flood threat. When a flood is imminent, it's often too late to prepare a flood response plan. Since no one knows well in advance when a flood is going to occur, the best time to start preparing a flood response plan is NOW!

When you're up to your rear in alligators, it's too late to start wondering why you're draining the swamp!

A flood response plan should be designed to suit the local area. It can range from very simple to extremely complex, depending on the size and geographic complexity of the jurisdictional area. It can also vary depending upon local conditions such as the potential type(s) of flood(s) the local area may be subject to, and whether there are or are not existing flood protection works.

A typical flood response plan document should contain at least the following:

- aim: a brief statement of the purpose of the plan
- description of flood type(s), hazard(s) and risk(s)
- names of the **Emergency Coordinator** (Flood) and **Emergency Operations Group** (Flood Response) members
- authority: the legal basis for the **Emergency Operations Group** (Flood Response) to take charge of private resources and issue orders
- names of any support groups, volunteer groups and special skill groups
- responsibilities: who does what
- implementation procedures: how the **Emergency Operations Group** (Flood Response) will function, how the plan will be implemented (who, what, where, when and how)
- contact lists
- contingency plans
- evacuation routes
- a directory of required/available equipment, supplies and services
- how to request provincial and/or federal assistance
- distribution of the flood response plan.

There is nothing worse than individuals being told to do two different things in the same emergency situation.

If other government agencies, hospital, schools, businesses, families or individuals don't have a flood response plan, they should be encouraged to prepare one. If they do have a flood response plan, it should be kept up-to-date and should be compatible, or at least not in conflict, with the flood response plan of the Local Authority or Diking Authority.

Consult with the Provincial Emergency Program and MELP - Water Management regional offices for information on flood response plans that may already exist in neighbouring local areas.

The *Local Authority Planning Guide (1996 Revision)* provides a great deal of useful background information on how a Local Authority can prepare an effective local emergency plan. Many Local Authorities may already have a local emergency plan. Much of the flood response plan may be modified from the local emergency plan, and may form an addendum to the local emergency plan.

The steps to prepare a flood response plan include:

- **prepare the aim;**
- **gather the necessary information;**
- **organize the administration and prepare the plan; and**
- **distribute, train, educate and review.**

PART 2 – FLOOD RESPONSE contains a Template for a Flood Response Plan, that can be used by any Local Authority or Diking Authority to assist them in preparing a flood response plan, or modifying an existing flood response plan.

3.2.1 Prepare the Aim

The aim of the flood response plan can be as simple as "to prevent any loss of life, to minimize injury and trauma to individuals, and to minimize damage to, and loss of property resulting from flooding on the _____ River(s) or Areas(s)." In general, the simpler the aim is, the better.

3.2.2 Gather the Necessary Information

To a large extent, most of the information required to prepare a flood response plan is already available. The trick is knowing what information is necessary and where to find it. Following that, the information has to be gathered and compiled. In some cases, information will not be readily available and will have to be created.

The necessary information can be expressed as a series of questions:

- What types of flood events may occur, what types have occurred?
- What are the risks to individuals and property from a flood?
- How can an impending flood be predicted?
- How can risks to individuals and property be reduced?
- How can flood warnings to individuals be disseminated?
- What evacuation strategies are there?
- What human and material resources are required/available to reduce the affects?

Some of this information is included in the following sections and in the Appendices. Additional sources of information can be found in PART 1, Section 4. Provincial Emergency Program and MELP - Water Management regional offices may know the whereabouts of additional information specific to the local area.

What types of flood events may occur, what types have occurred?

First identify types of floods the local area may be subject to, and the likelihood of those events occurring in the future. This can usually be done by determining the types of past flood events and the frequency of their occurrences. Check with MELP - Water Management, Ministry of Transportation and Highways and Provincial Emergency Program regional offices and long time residents.

If the local area is subject to more than one type of flood, determine the risks from the different types of floods separately.

What are the risks to individuals and property from a flood?

Next determine what geographic areas would likely be affected by various flood levels. This can best be done by using the most up-to-date detailed topographical maps available. Topographical TRIM (Terrain Resource Information Management) maps exist for the entire province at 1:20,000 scale or larger. Check with MELP, Geographic Data BC, in Victoria.

The Local Authority or the MELP - Water Management regional office will know whether floodplain mapping is available for the local area (available through Crown Publications in Victoria). (The location of floodplain mapping information is available at on the Internet at www.env.gov.bc.ca/).

Then assess the likely consequences, for various flood levels, to:

- individuals (health and safety);
- property (in rough order of importance): emergency response facilities, emergency access/evacuation routes, hazardous goods storage areas, hospitals and care facilities, water/sewage treatment plants, schools, churches and community halls, government buildings, commercial buildings, full time residences, part time residences, outbuildings with livestock, outbuilding without livestock, public roads, public utilities, private roads, agricultural land (cultivated, pasture, cleared), other;
- social and economic impacts; and
- environment (if applicable).

Consequences can be simply summarized in tabular form by area, land use, number of homes and residents or businesses and occupants, developed area and estimated value of development. For example:

Area	Land use	Homes / Businesses Residents Occupants	Developed area	Value$
1	Residential	100 / 300	50 ha	20 M
1	Sewer/water		10 lineal km	15 M
2	Commercial	2/90	5 ha	10 M
2	Treatment plant		1 ha	15 M
3	Agriculture	20/60	1000 ha	7 M

How can an impending flood be predicted?

Some types of floods are more predicable than others. For situations where a flood is predictable, determine the most practical methods of predicting a flood for the local area. As a simple example, river levels can be correlated with rainfall, and then with the information provided by Environment Canada's three to five day weather forecasts (available on the Internet at www.weatheroffice.com), the likelihood of flooding can be predicted.

Local Authorities and Diking Authorities can make use of the following information:

- Environment Canada, Hydrometric and Environmental Data (Water Survey of Canada gauge information);
- Ministry of Environment, Lands and Parks Snow Survey information;
- tide tables, in combination with Environment Canada's three to five day weather forecasts;
- establish, maintain and monitor one or more water level gauges upstream of the area of interest;
- inspect dikes, with increased frequency during periods more prone to flooding; and
- comparison with historical flood levels.

Besides Environment Canada's three to five day weather forecasts, other government agencies also provide some information that is useful for flood prediction:

- MELP River Forecast Centre, in Victoria, gathers and can provide information on snow pack and predicted freshet water levels for certain rivers in the province;
- MELP and Ministry of Transportation and Highways regional offices may be able to provide information on past flood events including snowpack, rainfall amounts, water levels and extent of flooding;
- Provincial Emergency Program is associated with the Tsunami Warning System in the Pacific, an international program to provide timely information and warnings of tsunamis; and
- Links with other Local Authorities or Diking Authorities upstream may be able to provide advance warning information.

If the local area is subject to more than one type of flood, several different types of predictive methods may be required.

How can risks to individuals and property be reduced?

Based on the type and severity of risks to individuals and property determined above, identify all the methods that can be used to reduce the affects.

With regards to individuals, this will involve keeping them informed and may involve disseminating warnings and possibly evacuation. Warnings and evacuation are discussed in the following sections. Determine what are the likely needs and special needs (medical and physical) of those in the area. Are hospitals, care facilities, schools likely to be affected?

With regards to property, this may involve flood fighting measures such as constructing temporary dikes or temporarily raising existing dikes in strategic locations, or preventative measures such as shutting off certain utilities or carrying out precautionary actions so that storm and sanitary sewers don't back up, identifying storage areas for hazardous materials, or providing safe havens for pets and livestock.

Plan to get the lives of individuals, the activities of the Local Authority or Diking Authority and local utilities, such as hydro, gas, water and sewer back to normal as quickly as possible after the flood.

How can flood warnings to individuals be disseminated?

There are numerous ways to disseminate warnings to individuals in a potential flood area. There is no single correct method. It depends upon many things, such as, the time available, the existing infrastructure and the human resources available.

Figure 1 summarizes several methods including: radio and television; Internet website, mass warning systems (sirens, whistles, church bells); mobile public address systems; fan out (or pyramid) systems; and door to door, and lists the advantages and disadvantages of each.

Warnings sometimes lead to evacuations. A Local Authority has the power to order evacuation under the provisions of the *BC Emergency Program Act*.

There are standard evacuation stages, and these should be incorporated into the warnings:

- **Evacuation Alert:** Prepare to evacuate your premise. Monitor news sources, such as radio, and keep your telephone free. Move children, disabled persons, pets and livestock out of the potential flood area.
- **Evacuation Order:** Everyone must leave the area immediately. The area will have controlled access, and a pass may be required to access the area. The police will enforce the evacuation order.
- **All Clear:** You are allowed to return to the area. There is a possibility, however, the emergency may re-occur. Continue to monitor news sources.

Identify the best one or two alternatives for disseminating flood warnings and prepare any necessary maps and handouts beforehand. Determine when to issue various levels of warning as well as what to include in each level of warning. It is useful to have some typical warnings already written that can be modified for the situation. For examples, refer to Figures 2 and 3.

What evacuation strategies are there?

Flood evacuation strategies will change with flood levels. Land, water and air strategies should all be considered. Land evacuation routes at lower flood levels may be impassable at higher flood levels. Determine the most practical and safest flood evacuation strategies, routes and alternate routes for the entire range of potential flood levels.

Other things to consider include:

- How are individuals with special needs such as elderly, physically challenged, school children, medical emergencies going to be evacuated?
- Have essential utilities and communication facilities been protected?
- How should individuals prepare their house or business before they leave?
- What should individuals bring with them and what should they leave?
- What about pets and livestock?
- Where are individuals going to be evacuated to, and how safe is that location from higher flood levels?
- How many people can the evacuation site handle?
- What is required at the evacuation centre: registration, heat, food, bedding, first aid, counselling, and entertainment or other diversions?
- What additional supplies are needed?
- Where are checkpoints going to be established, and by whom?
- What about security of the evacuated area following an evacuation?
- Who provides the security and how are they identified?

Some information that can be provided to individuals before evacuation is included in PART 1, Section 4.

What human and material resources are required/available to reduce the flood affects?

Depending upon the jurisdictional area, and the type and magnitude of the flood, some, or perhaps a great many human and material resources will be required during a flood. In the information gathering phase, determine both the required human and material resources, identify the available resources and determine how any shortfall of resources will be overcome. Consider first those human and material resources available in the local area, and then those available from neighbouring areas, including the practicality of obtaining them when necessary.

Human resources may include:

- Local Authority, Dam and Diking Authority employees;
- police, fire, search and rescue, medical/ambulance/first aid/military;
- those with special skills such as local construction contractors, helicopter companies, boat operators, bus drivers, ham radio operators, and local professionals;
- other government agencies such as Provincial Emergency Program, MELP, Transportation and Highways, and/or Forests; and
- volunteer groups such as Red Cross, St John's Ambulance, Salvation Army, service clubs, Boy Scouts, church groups.

The safety aspects of flood planning and response activities are very important and must be carefully considered during all phases. Safety requirements should be developed. Supporting information is included in PART 2 – FLOOD RESPONSE.

Material resources may include:

- Local Authority and Diking Authority equipment and supplies such as construction equipment, pumps, empty sand bags, sand, gloves, shovels, VHF radios;
- equipment and supplies that can be rented or purchased locally, including heavy equipment, helicopters, boats and buses;
- equipment and supplies available from government agencies;
- equipment and supplies that can be rented or purchased from neighbouring areas; and
- facilities and supplies for the Emergency Operations Centre (discussed below) and an evacuation centre.

Figure 4 provides a typical resource directory.

As well as the human and material resources required and/or available, determine the estimated costs and any lead time required to procure these resources. If many of these resources are not locally available, investigate developing a mutual aid plan with a neighbouring Local Authority or Diking Authority. They may "be in the same boat"!

3.2.3 Organize the Administration and Prepare the Plan

Once all the questions in the above section on information gathering have been answered and compiled, it's time to organize the administration and prepare the flood response plan. Several types of response organizations are presently being used in the province:

- the Incident Command System;
- the Emergency Operations Centre organization; and
- the departmental organization.

The provincial government and its agencies are adopting the Incident Command System, while some Local Authorities use an organization based on their departmental organization. Both are described briefly in PART 1, Appendix C. This document will use the Emergency Operations Centre organization, as outlined in the *Local Authority Planning Guide (1996 Revision)*.

Who? What? Where? When? How?

Who?

The "who" is the administration organization of the flood response plan. This administration organization should be housed in an **Emergency Operations Centre** (Flood Response), or **EOC**. This is the same **EOC** that has been organized by Local Authorities for their local emergency plans under the *BC Emergency Program Act*. Diking Authorities may wish to follow the same organizational structure or use the Incident Command System or departmental organization outlined in PART 1, Appendix C. For further information on an **EOC**, refer to the *Local Authority Planning Guide (1996 Revision)* and documents and training courses prepared by PEP and the Justice Institute.

The **EOC** should obviously be located in a flood safe area, and be relatively self sufficient with respect to matters such as power, communications, washrooms, and food. It should be large enough for efficient operations including areas for maps, display boards, and a rest area. It is often a good idea to separate the **EOC** from the evacuation centre, the public, and the media.

The entire flood response plan is overseen by the **Emergency Coordinator** (Flood Response). The **Emergency Coordinator** is often an employee or a member of the Local Authority or Diking Authority, and reports to the **Emergency Operations Group** (Flood Response) of the Local Authority or Diking Authority.

Emergency Operations Centre: "Where uncomfortable officials meet in unaccustomed surroundings to play unfamiliar roles making unpopular decisions based on inadequate information and insufficient time." – Anon

The **Emergency Operations Group** (Flood Response) is responsible for directing and controlling the flood response and is composed of officials who are responsible for providing the essential services necessary to minimize the effects of a flood on the area. Many of its members will also be members of the local emergency plan's **Emergency Committee**:

- **A senior representative** or two from the Local Authority or Diking Authority;
- **Emergency Coordinator and Assistants**, responsible for all aspects of flood response in specific geographic areas;
- **Human Resources Coordinator**, responsible for providing and deploying human resources;
- **Material and Services Coordinator**, often the Local Authority or Diking Authority Engineer, responsible for providing and deploying equipment, supplies and services;
- **Dispatch Coordinator**, responsible for communications between **EOC** and thevarious geographic areas, including those individuals affected by the flood;
- **Public Information Officer**, responsible for media and general enquiries; and
- **Administrator**, responsible for cost accounting.

Others that can be included in the **Emergency Operations Group** (Flood Response) include:

- heads of police, fire, search and rescue, responsible for law enforcement, fire fighting, and search and rescue;
- public health officer, responsible for medical/ambulance/first aid, health and safety;
- emergency social services official, responsible for evacuation centre; and
- heads of any other appropriate agencies.

The size and complexity of the **EOC** and the **Emergency Operations Group** (Flood Response) will vary depending upon the size and complexity of the local area and the flood event. For small areas and small flood events, one individual can wear several hats.

What, Where, When and How?

The what, where, when and how is the flood response plan. The **Emergency Coordinator** (Flood Response) oversees the preparation of the flood response plan, delegates the various aspects of the planning process to the appropriate members of the **Emergency Operations Group** (Flood Response) and establishes realistic dates for completion. A good flood response plan assigns specific duties to every member of the **Emergency Operations Group**.

The plan must set objectives, and priorities and strategies to achieve those objectives. Prioritization of activities is very important especially since response activities may be constrained by the available resources. If a table showing the consequences of flooding has been prepared, as discussed in PART 1, Section 3.2.2, response priorities can be based on the number of residents/businesses, type and value of development potential affected.

To assist local decision making, the following priorities form the basis of the provincial response to floods. "In responding to a flood event, the actions and decisions of the province will be based on the priorities to protect the following: human life; provincial infra-structure (roads, communications & utilities); property; environmental resources" *BC Flood Plan (April 1998).*

It is best to develop a number of phases of flood response and correlate these phases with thresholds, such as river levels, predicted intense storms or some other measure of the potential severity of the flood. As a simple example:

Phase	Activated	Will...
I	by Environment Canada's three to five day weather forecast of a specific intensity of rainfall	• alert the Emergency Operations Group (Flood Response) • initiate monitoring of river levels.
II	when river levels reach a certain level	• activate the EOC and the Emergency Operations Group (Flood Response) • initiate dissemination of information to individuals in the area likely affected • initiate measures to prevent damage to property • initiate more frequent monitoring of river levels.
III	when river levels reach a certain higher level	• activate the dissemination of an Evacuation Alert • initiate preparations of an evacuation centre • initiate actions to minimize further property damage • initiate still more frequent monitoring of river levels.
IV	when river levels reach a still higher level	• activate the dissemination of an Evacuation Order • open the evacuation centre • initiate further actions to minimize property damage • initiate continual monitoring of river levels.
V	by subsiding water	• activate the post flood activities of the flood response plan.

In this example, Phases I and II are "pre-flood phases", Phases III and IV are "flood phases", and Phase V is the "post flood phase".

In addition to the plan, each **Emergency Operations Group** (Flood Response) member for his/her area of responsibility should prepare a series of CHECKLISTS for each Phase of a flood outlining who should do what, where it should be done, when it should be done, and how it should be done, so that during a flood, **THINGS GET DONE**. See PART 2 – FLOOD RESPONSE, for sample flood response checklists.

The **Emergency Coordinator** (Flood Response) compiles the plans and checklists from the various **Emergency Operations Group** members. Every effort should be made to incorporate, or ensure the compatibility with, the flood response plans of other government agencies, hospitals, schools, businesses or individuals in the area.

The **Emergency Operations Group** (Flood Response) should review the compiled draft flood response plan to ensure that no obvious items have been missed, and the Local Authority or Diking Authority should approve both the plan and the document.

3.2.4 Distribute, Train, Educate and Review

Once the flood response plan is complete, it is important that the document is distributed to all appropriate individuals, such as members of the **Emergency Operations Group** (Flood Response), organizations, such as the school boards, police, fire, search and rescue (if they are not part of the **Emergency Operations Group**), and government agencies such as Provincial Emergency Program and MELP - Water Management regional offices.

Everyone associated with the Local Authority or Diking Authority and everyone involved in the flood response plan should be informed and trained what to do during a flood situation. When new staff are hired, they should be provided with training.

All residents and businesses in the local area should be made aware that a flood response plan exists. A summary document or a press release explaining the main elements of the plan should be distributed to all.

A neighbourhood flood preparedness program, a logical component or extension of a neighbourhood emergency preparedness program, should be considered. This will allow individuals in flood prone neighbourhoods to know, well before the threat of a flood, what to do before, during and after a flood.

It may be useful to organize and hold a flood planning response workshop for the general public. It may also be useful to test the plan. Five types of flood response exercises are summarized in Figure 5.

A flood response plan should be considered a living document: things change, people change. The flood response plan should be reviewed and amended if necessary, at least once a year, or more frequently if there is a change of **Emergency Operations Group** (Flood Response) members. Lists should be prepared on separate pages so that they can be easily updated when contact names and numbers change.

3.3 Implement a Flood Response Plan

When and where a flood event is predictable, a flood response plan can be implemented as one or more "pre-flood phases" and "flood phases". Pre-flood phases usually begin when a flood threat is predicted or is imminent. For unpredictable flood events, these phases may be very short, or may not exist, and the flood response plan proceeds directly to the "flood phases".

3.3.1 Pre-flood Phases

The pre-flood phases initially alert the **Emergency Operations Group** (Flood Response) of the possibility of a flood, and then activate the **EOC** (Flood Response). To the maximum extent possible, checklists should used to ensure all that all the tasks within each phase are carried out as planned. An example checklist for flood fighting is provided as Figure 6.

Once the flood response plan, the **EOC** and the **Emergency Operations Group** are activated, begin regular meetings, review the plan, begin record keeping, both secretarial and financial.

Then, depending on the flood response plan and size of the predicted flood, a whole series of activities may begin. For example:

- begin periodic monitoring/forecasting. Monitoring logs, such as the Dike and River Assessment Information Log provides a checklist for inspectors/technicians. Ensure that sufficient copies are prepared beforehand;
- alert police, fire, search and rescue, medical/first aid if they are not on the **Emergency Operations Group** (Flood Response);
- alert the Provincial Emergency Program, other appropriate government agencies and neighbouring jurisdictional areas;
- alert the owners of the local utilities;
- review specific activities associated with utilities and sewers, and alert public works;
- prepare staging areas, check availability of human resources and material resources. If necessary, alert human resources and either start to collect or order material resources;
- review flood fighting methods and alternative;
- check dispatch communications (phones, cells, VHF radio, ham radio operators), and begin communication between the **EOC** and field;
- keep hospitals, care facilities, schools, businesses and individuals informed and begin media releases. If appropriate, accredit media and offer media tours;
- check warning systems and review evacuation strategies;
- check preparedness of evacuation facilities;
- advise the public and provide them with guidance (news releases); and
- continually monitor and assess the situation and consider all contingencies.

With all these activities taking place, it is easy to see why it's so important to have a well thought out flood response plan and a series of checklists.

3.3.2 Flood Phases

The flood phases of a flood response plan are usually activated immediately before the flood occurs or, if there is little or no warning, immediately after the flood event has begun. If there is little or no warning of the event, still review the pre-flood phases

of the flood response plan. Although many of the pre-flood activities may not be necessary, or are now inappropriate, there may be some important activities that may be otherwise overlooked.

"If you don't think things can get worse, just wait." – Anon

As for the pre-flood phases, to the maximum extent possible, use checklists to ensure all that all the tasks within each phase are carried out as planned.

Depending on the flood response plan and size of the actual flood, many more activities may begin or those underway may continue or increase in scope. For example:

- increase the frequency of monitoring/forecasting;
- call upon the police, and if necessary, fire, search and rescue, medical/ ambulance/first aid for law enforcement, crowd and traffic control, evacuation of an area, checkpoints and security patrol, fire fighting, search and rescue of missing persons, medical/first aid services;
- keep the Provincial Emergency Program, other appropriate government agencies and neighbouring jurisdictional areas informed;
- put staging areas into operation, call upon and deploy human resources as required, and deploy equipment, supplies and services as required;
- address safety issues;
- carry out required activities associated with utilities and sewers;
- ensure that structures, such as bridges and culverts are kept clear of debris;
- begin flood fighting methods, such as sandbagging, if required. Refer to PART 2 – FLOOD RESPONSE for examples of flood fighting methods;
- notify the local offices of the MELP and federal Department of Fisheries and Oceans of flood response activities;
- don't commit all the resources at first, the situation may escalate or the scope may widen;
- continually assess the effectiveness of resources used and be prepared to change the resource allocation(s) depending on the priority issues and areas that are or become subject to flooding;
- continue dispatch communications (phones, cells, VHF radio, ham radio operators) between the EOC and field, including residents;
- continue to keep hospitals, care facilities, schools, businesses and individuals informed;
- if necessary, issue Evacuation Alert or Evacuation Order, and follow evacuation strategies;

- if necessary, open evacuation centres, with registration and emergency social services and considerations for pets and livestock;
- continue media releases, hold news conferences (possibly at specific times), arrange interviews, correct misinformation; and
- as for the pre-flooding phases, continually assess the situation and consider all contingencies.

Checklists make things happen.

3.3.3 Environmental Considerations

During flood response activities, care should be taken to protect natural environmental resources to the greatest extent possible. Where possible, advance notice of possible flood response works should be given to both MELP and federal Department of Fisheries and Oceans for their consideration and advice.

For flood events declared under the authority of the *BC Emergency Program Act*, the province has defined special requirements under the Section 9 Regulation of the *BC Water Act*. Works for flood protection and the clearing of obstructions by a provincial or municipal government during a flood emergency must be reported to a habitat officer of the MELP within 72 hours of making the change, in accordance with Section 40(4) of the Regulation. Further information is available in the publication *A Users Guide To Working In and Around Water*, see PART 1, Section 4. Note that the regulation does not extend to the federal Department of Fisheries and Oceans.

3.4 Post Flood Management

"It ain't over 'til it's over." – Yogi Berra

3.4.1 Recovering from a Flood

One of the major goals of a flood response plan is to lead to a speedy recovery. Therefore the flood response plan should have a section on how to recover from a flood. The sooner the recovery process begins after a flood, the sooner the local area will return to its pre-flood condition. Often flood recovery can begin even before the flood itself has past, as the water is subsiding.

The post flood phase of the flood response plan should address two elements:

- getting hospitals, care facilities, schools, infrastructure, business and individuals back to normal as quickly as possible
- getting the activities of the Local Authority or Diking Authority back to normal business as quickly as possible.

After a flood, and if an evacuation order has been issued, before a Local Authority or Diking Authority issues an "all clear" it should:

- take an inventory of all the damage in the local area;
- document high water levels and the extent of flooding with bench marks, photographs and maps;
- identify ongoing hazards and risks;
- prioritize its activities;
- consider Environment Canada's three to five day weather forecast;
- ensure safe access and safe and adequate utilities (hydro, gas, water, sewer); and
- inform the public as to the appropriate precautions (see below).

Communications are an important aspect in the post flood section of the flood response plan.

Individuals will want to return to their residences and businesses as soon as possible. There are certain precautions returnees should take, and these should be provided to homeowners, landlords, individuals and business owners. These include:

- assessing any structural damage;
- ensuring utilities are safe (hydro, gas, water and sewer);
- ensuring domestic wells are safe;
- cleaning flood soaked clothing and bedding;
- considering contamination of shelf food, refrigerator food, and frozen food;
- ensuring personal hygiene during clean-up;
- considering special procedures for cleaning up basements and other flooded rooms;
- using disinfectants for flooded basements;
- disposing of hazardous materials;
- following appropriate disaster assistance programs, such as those offered through the Provincial Emergency Program (PEP), that may be available;
- considering physical and psychological damage (trauma).

PART 1, Section 4 includes sources of additional information that cover various topics associated with returning to a flood scene and cleaning up from a flood.

The Local Authority or Diking Authority should also consider damage assessment of its facilities. Although usually the task of a government agency, other topics that should be considered in post flood phases of a flood response plan include:

- temporary housing;
- health and safety information;
- physical restoration;
- disposal of sandbags (biodegradable bags are easiest to dispose);
- reconstruction;
- counselling;
- media relations (reports of flooding can affect tourism and media coverage may be necessary to reassure the public); and
- insurance and/or disaster financial assistance programs that may be available.

These topics are beyond the scope of this guide.

3.4.2 Debriefing and Review

Debriefing and review of the flood response plan should take place some time after the flood and when the post flood recovery phase is complete or nearing completion.

At this point, the Local Authority or Diking Authority can review and evaluate the strengths and weaknesses of its flood response plan, and make improvements. It can design and carry out mitigative studies and works to reduce the risks from the next flood.

No one knows when, but if one flood occurred, another flood is likely.

Ice jam removal at bridge

4. References

4.1 Selected Major References and Sources of Information (in alphabetical order)

Alberta, Disaster Services

Tel: 780 422-900

Alternatives to sandbags for temporary flood protection, October 1998.

Flood disaster and what to do before and after flooding
Information on ways individuals can help themselves and their families.

American Red Cross, Disaster Services

Internet: www.redcross.org/disaster/
Information on many flood-related topics and publications including: Flood preparedness; Family disaster planning; Checklist for people with mobility problems; After the flood; Repairing your flooded home.

(US) Army Corps of Engineers

Attn: CECW-PF, 20 Massachusetts Avenue, NW, Washington, DC, 20314
Publications on flood proofing
Internet: www.usace.army.mil/inet/functions/cw/cecwp/fpreg
Information on sandbag construction, placement, estimation of numbers
Internet: www.ncb.usace.army.mil/emb/sandbag.htm

Boston, Noel

1997: *Human factors in emergency preparedness.* British Columbia Association of Professional Engineers and Geoscientists, Innovation, December 1997

BC Government

1996: *BC Dike Maintenance Act*

1996: *BC Drainage, Ditch and Dike Act*

1996: *BC Emergency Program Act*. See Sections 6(2), 6(3), 8(1), 12(1), and 13(1) and *Guide to the Emergency Program Act*. Also available on the Internet: www.pep.bc.ca

1996: *BC Municipal Act*

1996: *BC Water Act*. See Section 9(2) and *A Users Guide to Working In and Around Water*.

BC Ministry of Attorney General (Provincial Emergency Program)

1996: *Local Authority Planning Guide*. 1996 Revision, updated in October

1998. Also available on the Internet: www.pep.bc.ca

Headquarters, 455 Boleskine Road, Victoria, BC, V8Z 1E7, with six Regional Offices
Tel: 1-800-663-3456 Internet: www.pep.bc.ca
All sorts of information and publications on flood and tsunami planning and preparedness including: *BC Emergency Program Act*; *Guide to the Emergency Program Act*; *Flood precautions for homeowners*; *Floodproofing your home, minimize damage*; *Self-help advice, floods*.

Links to Emergency Preparedness Information Exchange (EPIX) at Simon Fraser University, Emergency Preparedness Canada, Justice Institute of BC, and other provincial and state emergency measure organizations.

BC Ministry of Environment, Lands and Parks

Tel (Victoria): 250-387-1531 Internet: www.env.gov.bc.ca/wa/flood/
Information on flood hazard management, Regional Offices and Headquarters.

1996: *Management of Flood Protection Systems in BC*, by P.J. Woods, Inspector of Dikes, in Proceedings of the Canadian Water Resources Association Watercourses Conference, Vancouver, BC, October

1998: *Dam Safety Guidelines*. Prepared by the Public Safety Section, Water Management Branch

1998: *Water Related Hazards, Emergency Response Plan and Procedures*. Internal government publication

1999: *Guidelines for Management of Flood Protection Works in BC*, prepared by Public Safety Section, Water Management Branch

BC Ministry of Transportation and Highways

Emergency Response Plan - 1992
BC Ministry of Transportation and Highways
Describes emergency services delivered by MOTH personnel.

Round IV (1995-6) Maintenance Services Manual
Standards for Road and Bridge Maintenance Services (Maintenance Standards)
August 31, 1995
BC Ministry of Transporation and Highways
Describes emergency services delivered by MOTH maintenance contractors.

1996: *Natural Hazards in British Columbia*, Section 3.4, Flooding. Prepared by the Geotechnical and Materials Branch

1998: *BC Flood Plan*. Prepared by BC Ministry of Transportation and Highways, BC Ministry of Attorney General (Provincial Emergency Program) and BC Ministry of Environment, Lands and Parks

Also available on the Internet: www.pep.bc.ca

California Department of Food and Agriculture

Internet: www.cdfa.ca.gov/newsinfo/news/
Information on topics including disaster guidelines for livestock and for pet owners.

California Department of Water Resources

Flood Fighting Methods
Volume II - Revised 1997
Division of Flood Management
Flood Operations Branch

Canada, Government of

1985: *Emergencies Act* (Canada)

1985: *Emergency Preparedness Act* (Canada)

Canada Mortgage and Housing Corporation

700 Montreal Road, Ottawa ON K1A 0P7
Tel: (613) 748-2367 or 1-800-668-2642/Fax: 1-800-245-9274
E-mail: chic@cmhc-schl.gc.ca Internet: www.cmhc-schl.gc.ca
Information on cleaning, repairing and renovating homes after a flood.

Canadian Conservation Institute

1030 Innes Road, Ottawa ON K1A 0M5
Tel: (613) 998-3721/Fax: (613) 998-4721
Internet: www.pch.gc.ca/cci-icc
Information on cleaning, repairing and renovating homes after a flood.

Duncan, J.M., Mitchell J.K., Lovern C., and Coffey J.

1997: *Innovative alternatives to conventional levees for flood protection.*
Department of Civil Engineering, Viginia Tech, Blacksburg, Virginia,
Report 24061-0105

Emergency Preparedness Canada and Canadian Mortgage and Housing Corporation

1998: Self-Help Advice, Floods, What to do before and after. Also available on the Internet: www.pep.bc.ca or hoshi.cic.sfu.ca/epc

Emergency Plan Development

Internet: www.emergency-planning.com/sample/Basic
A method for preparing an "all-hazard" emergency operations plan. Lots of good ideas.

Emergency Planning for the Home

Internet: www.achilles.net/~alwillms/emergency/index.html
Emergency planning for the home in one HTML document.

Emergency Preparedness Canada

122 Bank Street, 2nd Floor, Ottawa ON KIA 0W6
Tel: (613) 991-7035/Fax: (613) 998-9589
E-mail: communications@epc-pcc.x400.gc.ca Internet: hoshi.cic.sfu.ca/epc

Environment Canada

Internet: www.weatheroffice.com
The source for weather in Canada

(US) Federal Emergency Management Agency (FEMA)

Tel: 1-800-480-2520
Internet: www.fema.gov
Among other things, publications including: *Mitigation*; *Family disaster planning*; and *Flood emergency and residential repair*.

(US) The Floodplain Management Web Site

Internet: www.floodplain.org
Information on floodplains and their management.

Fraser Basin Management Board

1994: *Review of the Fraser River Flood Control Program*

Illinois Department of Transportation (Division of Water Resources) and Illinois Emergency Services and Disaster Agency

1985: *Flood fighting*

Illinois Department of Natural Resources, Office of Water Resources

524 South Second Street, Springfield, Illinois, 62701-1787, USA
Publications include: *Flood fighting; Protect your home from flood damage; Floodplain management; Flood hazard mitigation; Floodplain compliance; Flood hazard mitigation plan, Village of Thebes, Illinois; Flash flood handbook; Flooded basements, a homeowner's guide; Elevating flood-prone buildings, a contractor's guide.*

A number of these publications are out of print and are presently being updated to be reprinted.

Illinois Emergency Management Agency

110 East Adams Street, Springfield, Illinois, 62706, USA
Internet: www.state.il.us/iema/flood.htm
Publications include: Flood emergency and residential repair handbook; Guide for flood preparedness planning.

Justice Institute of BC

715 McBride Boulevard, New Westminster, BC, V3L 5T4
Tel: 604-528-5790 Fax 604-528-5798 email emd@jibc.bc.ca
The Emergency Management Division offers a wide rage of courses on emergency management. Its library (library@jibc.bc.ca) contains publications on mitigation, preparedness, recovery, and response, and videos
(see BC Ministry of Attorney General (Provincial Emergency Program) Internet site for a link to the Justice Institute)

1997: Emergency Operations Centre (EOC). Course notes

Manitoba

Internet: www.net-mark.mb/html/profile/flood
Information on the 1997 Red River flood including: information on building a dike; how to keep the public informed; returning home after the flood; health related issues after the flood, including food, hygiene, basement clean up and sandbag removal.
Internet: www.gov.mb.ca/flood/after
Information on procedures for returning home including determine if your home is safe, restore the utilities, clean up, health and hygiene, and rebuilding and flood proofing.

Michigan Department of Natural Resources, Land and Water Management Division

1988: *Flood Hazard Mitigation Handbook*

New Brunswick, Environment

1989: *New Brunswick River Ice Manual*
Prepared by The New Brunswick Subcommittee on River Ice
Environment Canada New Brunswick
Inland Waters Directorate, Department of the Environment
August 1989

Internet: www.gov.nb.can/environm/
Provides information on ice jam development and also ice control and removal techniques.

(US) National Technical Information Service, US Department of Commerce

Springfiled, Virginia, 22151, USA
Publications include: *Community handbook on flood warning and preparedness programs* (prepared for the US Army Corps of Engineers); *Flood warning system, does your community need one?*; *Information for local officials on flood warning systems*

Safe Guard Secretariat

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Tel: (514) 868-1562 or 1-800-830-3118/Fax: (514) 868-0330
E-mail: sgarde@cam.org Internet: www.safeguard.ca
Safe Guard is a national information program to increase public awareness of emergency preparedness in Canada. It brings together government, private and voluntary organizations that are part of the emergency planning, response and recovery community.

4.2 Videos

Planning for Floods, another look at rising water (30 minutes, 1993) Produced by the (US) Environmental Defence Fund, available with a $20 donation
Tel: 1-800-684-3322
Internet: www.edf.org/pubs

Sandbag dike at Mission Creek

FIGURE 1: WARNING DISSEMINATION METHODS

Mass warning systems: sirens, whistles, church bells, etc.

Advantages
Often already available in the fire department
Reaches large numbers of people rapidly in urban areas
Instils sense of urgency

Disadvantages
Cannot convey explanation of problem or instructions on what to do
May suddenly fail if dependent on telephone and electrical power for operation
Expensive for use in rural areas

Radio, television, and cable systems

Advantages
Receivers widely available
Low or no initial investment
Reaches large numbers of people rapidly during daylight and evening hours
Suitable for both urban and rural areas
Can convey explanation of problems and instructions for action

Disadvantages
Dependent on electrical power
Few people listening during late night and early morning
Local stations may be off the air during late night and early morning hours
Local station transmissions may not reach deep valleys

Internet Website

Advantages
Computers widely available
Reaches large numbers of people rapidly during daylight and evening hours
Low or no initial investment
Suitable for both urban and rural areas
Can give residents written instructions
Can convey explanation of problems and instructions for action

Disadvantages
Dependent on electrical power
All people do not have computers and/or Internet access

Mobile public address systems

Advantages
Reaches large numbers of people rapidly
Conveys sense of urgency
Usually low or no initial investment
Can convey explanation of problem and instructions for action
Suitable for both urban and rural areas
Person giving the warning can adapt procedures to the situation

Disadvantages
Local travel or flying may be prevented by weather or flooding conditions
May tie up police or other vehicles when they are needed

Fan out systems: telephone trees, block captains, etc.

Advantages
Low or no initial investment
Can convey explanation of problem and instructions for action
Suitable for both urban and rural areas

Disadvantages
Messages may become garbled through many relays
Vulnerable to rumours and speculation
Slow
Vulnerable to telephone system disruption

Door-to-door contact

Advantages
Can convey explanation of problem and information on what to do
Can give residents written instructions
Conveys sense of urgency
Persuasive
Suitable for both urban and rural areas
Low or no initial investment

Disadvantages
Slow
May interfere with other essential duties

Reference:
Flood Fighting, 1985 - Illinois Department of Transportation and Illinois Emergency Services and Disaster Agency

FIGURE 2: EXAMPLE OF WHEN TO ISSUE FLOOD WARNINGS

City of Floodville

Flood Warning Instructions

Actions to be taken by the Police Department Dispatcher when a flood warning is issued. Call:

- Emergency Coordinator (Flood Response) (telephone number)
- John Smith (telephone number) and ask him to monitor the river guage and call the Emergency Coordinator (Flood Response) when it reaches ___ metres.
- St James Hospital (telephone number) and ensure they know of the watch. (Note: St James Hospital was identified on the flood stage forecast map as a vital facility needing extra warning time to prepare itself for flooding.)

Actions to be taken by the Emergency Coordinator (Flood Response):

1. When the river gage reaches ___ metres:
   - Report to the Emergency Operations Centre
   - Contact the _____ for confirmation and their latest flood prediction.

2. When the gage reaches ___ metres, or when a flash flood warning is issued:
   - Call the Material and Services Coordinator (telephone number) to initiate sandbagging of the water works.
   - Call Natural Gas Company (telephone number).

3. When the gage reaches ___ metres or a flash flood on our river is confirmed:
   - Contact the radio/TV stations (CABC: telephone number) and (CDEF: telephone number).
   - Sound the siren for the flash flood warning (two short blasts) to warn people to turn on the radio.
   - Ask the police dispatcher to set up blockades at Bay and Johnson bridges to control traffic and close the bridges when water reaches them.
   - Contact the Fire Department to have standby crews report to Fires Station #3 to be available to assist in rescue operations.
   - Contact County Nursing Home (telephone number) to ensure they have the warning and are initiating their own protection measures in the lower floors.

Reference:
Flood Fighting, 1985 - Illinois Department of Transportation and Illinois Emergency Services and Disaster Agency

FIGURE 3: EXAMPLE OF FLOOD WARNING

City of Floodville

Flood Safety Instructions

You live in a flood hazard area - Keep these safety instructions handy.

When a flood warning is issued:

- Listen to your radio or TV for emergency instructions
- Keep a portable radio, emergency cooking equipment, and flashlights, first aid and medical supplies (prescriptions, insulin, etc.) at hand
- Keep your automobile fuelled
- Fill large containers with tap water for drinking and cooking
- Secure outdoor items that might be washed away
- Move household belongings to upper levels

When flooding starts:

- Shut off your utilities: cut off all electric circuits at the fuse panel or disconnect switch. If this is not possible, turn off or disconnect all electrical appliances. Shut off the water service and gas valves in your home.
- If you must evacuate, do so quickly and safely. See the attached map for protected evacuation routes. If you do not have any place to stay, go to one of the shelters shown on the attached map.
- Do not attempt to drive on a flooded road or walk if the water is above your knees or moving. If your vehicle stalls, abandon it immediately and seek higher ground.
- Do not handle live electrical equipment in wet areas. Beware of fire hazards such as piles of wet hay, feed, or charcoal, gas or oil leaks, and broken electrical wires.

Get a free copy of *Protect your Home from Flood Damage* from City Hall or one of the shelters. It has instructions for protecting your property and for cleaning up and restoring property after a flood.

Reference:
Flood Fighting, 1985 - Illinois Department of Transportation and Illinois Emergency Services and Disaster Agency

FIGURE 4: A TYPICAL RESOURCE DIRECTORY

Your resource directory should include business and residence telephone numbers for contacts at the following agencies and organizations and others.

Airports
Air Services
Ambulances
Auxiliary Lighting
BC Rail
BC Hydro
BC Gas
Boats
Bus Services
Caterers
Chemicals
Emergency Social Services
Churches
Coroner
CN Rail
CP Rail
Cellular Phones
Divers
Doctors
Elected Officials
Fire Departments
Food Suppliers
Fuel Dealers
Funeral Homes
Heavy Equipment
Helicopter Services
Health Services
Hospitals/Clinics
Pharmacies
Media-print/broadcast
Police
Radio Operators
Red Cross
Salvation Army
School Boards
Weather Office
St. John Ambulance
Taxis
Telephone Company
Towing Companies
Utilities/Pipelines
Volunteer Agencies
Welders

Reference:
Local Authority Planning Guide (1996 Revision) - BC Ministry of Attorney General - Provincial Emergency Program

FIGURE 5: TYPES OF FLOOD RESPONSE EXERCISE

FIVE TYPES OF EXERCISE

ORIENTATION SEMINAR

The orientation seminar is used to introduce or refresh participants to plans and procedures, by lecture, panel discussion, media presentations, or talk through. All levels of personnel (policy, coordination, operations, and field) are involved.

DRILL

The drill tests a single emergency response function. It involves actual field response. Its effectiveness lies in focusing on a single, or relatively limited portion of the overall response system in order to evaluate and improve it.

Training in the development of an exercise program is availablethrough the provincial emenrgency program academy at the Justice institue of BC.

TABLETOP EXERCISE

In a tabletop exercise actions and discussion are based on a described emergency situation plus a series of messages to players. Participants practice problem-solving for emergency situations through on-going discussion and critique of the appropriateness of actions taken and decisions made. Participants also practice coordinated and effective response. The tabletop permits breaks before new messages are delivered to discuss proper response. It will involve policy and/or coordination personnel.

FUNCTIONAL EXERCISE

The functional exercise is a simulation of an emergency that includes a description of the situation, a timed sequence of messages, and communication between players and a simulation group. For example EOC members could practice coordinated, effective response in a time-pressured, realistic emergency situation. Individual and system performance is evaluated. It will involve policy and coordination personnel.

Reference:
Local Authority Planning Guide (1996 Revision) - BC Ministry of Attorney General - Provincial Emergency Program

FULL-SCALE EXERCISE

The full-scale exercise adds a field component to interact with a functional exercise through actual and simulated messages. It tests the deployment of seldom used resources and will involve policy, coordination, operations and field personnel.

FIGURE 6: AN EXAMPLE CHECKLIST

This checklist includes many different possible flood fighting activities that should be considered for a flood fighting plan. Not all of these activities will apply to any one Local Authority or Diking Authority. Select those appropriate to local flood situations that can be implemented given available resources during a period of haste, tension, and power outages.

- ❑ Send rain and river gage readers out to monitor their gages.
- ❑ Check pumps and other equipment to ensure they are available and will operate. (This should also be done at least once each year.)
- ❑ Open the Emergency Operations Centre.
- ❑ Begin periodic dike patrols. Check gates for rust, ice, or anything that may keep dikes and works from working (this should also be done at least once each year). check for sand boils and flood heights that approach overtopping. Do not attempt to cover boils, they should be encircled with sandbags. The MELP can provide technical assistance on dike patrols and dealing with seepage, boils, and other dike problems.
- ❑ Begin schedule of regular meetings of key personnel to review and plan flood fighting operations.
- ❑ Send status reports to the Provincial Emergency Program.
- ❑ Organize search and rescue squads to check flooded areas for stranded residents (especially in flash flood areas).
- ❑ Provide traffic control services along designated evacuation and access routes.
- ❑ Control access into flooded area and watch for looters. If necessary, institute an identification tag system so that only authorized personnel move through the flooded areas.
- ❑ If access to the other side of the river will be cut off, move fire truck(s) and other essential services to be able to cover both parts of town.
- ❑ Establish central fuel depot to ensure enough fuel for pumps, generators, trucks and other flood fighting equipment.
- ❑ Fill bulk fuel tanks to prevent floating.
- ❑ Mark gas station pumps with floats so boats can avoid them.
- ❑ Mark fencelines with floats to provide warning for rescue boats.
- ❑ Order evacuation of threatened areas, provide assistance to the elderly, physically challenged, and others needing it.

- ❑ Assist elderly or physically challenged in shutting off gas and electricity and securing threatened buildings.
- ❑ Order/supervise removal of mobile homes and other property that can be removed before the flood arrives.
- ❑ Move or otherwise protect valuable city property, especially files, records, motors, vehicles, and wooden furniture.
- ❑ Have volunteers or emergency workers fill sandbags.
- ❑ Arrange for feeding and sleeping facilities for volunteers.
- ❑ Open temporary shelters.
- ❑ Arrange for centrally controlled ferry service for people who must get in and out of their flooded properties.
- ❑ Close businesses that could be hazardous when flooded such as gas stations and facilities with hazardous materials.
- ❑ Close businesses such as liquor stores, bards, and entertainment centres to facilitate area control.
- ❑ Close schools that are threatened by the flood, especially high schools and colleges that can release able-bodied volunteers for flood fighting.
- ❑ Coordinate with utility companies to ensure that main shut offs will be in time and will not interfere with your flood fighting activities.
- ❑ Implement alternate water use rules if wells are shut down.
- ❑ Close sewer lines that will cause flooded basements in areas not flooded by surface water. Manual stoppers can be made of lumber, sandbags, and plastic sheeting. They should be placed at the discharge end of the outsell pipe. There are commercially sold pipe plugs which are inflated to seal a sewer line. Manholes may have to be sandbagged to keep backed up sewers from flooding the streets.
- ❑ Monitor bridges and culverts and keep them cleared of debris which may plug them up.
- ❑ Maintain gage watching to be alert for a second crest.
- ❑ Keep the public informed. Issue announcements periodically via mass media, community bulletin board, or personal contact on:
  - latest predictions on flood crest and duration,
  - where to go for medical care and emergency assistance,
  - location of shelters,
  - what evacuation routes are open,
  - any new or special hazards such as downed power lines.

APPENDICES

Appendix A: SUMMARY OF ROLES AND RESPONSIBILITIES

Floods affect everyone, and therefore everyone should work towards reducing the affects. Both federally and provincially, there is legislation designed specifically to help various levels of government plan for and respond to floods.

Individuals

Regardless of governmental involvement, the first line of defence against floods always rests with the individual. All homeowners, landlords and individuals, although not mandated by legislation, have a responsibility to protect their homes and families to the greatest extent possible. It is up to each individual to know what to do in an emergency. Individuals living in flood prone areas should be aware, or made aware, of that fact so they can take appropriate precautions in regard to their living arrangements and their planned response to a flood event. Refer to available Individual and Family Preparedness information in PART 1, Section 4.

Local Authorities

Under the BC Emergency Program Act (*BC EPA*, 1996), Local Authorities include:

- all municipalities;
- regional districts if they have been granted the powers of a municipality;
- under the Municipal Act; and
- national parks if an agreement has been made between the Government of Canada and the province.

As of June 1998, 15 regional districts in the province have been granted the powers of a municipality.

Local authorities, for their jurisdictional area:

- must prepare a local emergency plan (*BC Emergency Program Act*, Section 6(2));
- must establish and maintain an emergency management organization (BC *Emergency Program Act*, 1996, Section 6(3));

- may cause the plan to be implemented (*BC Emergency Program Act*, 1996, *Section 8(1)*);
- may declare a state of local emergency (*BC Emergency Program Act*, 1996, *Section 12(1)); and*
- may do all acts and implement all procedures that it considers necessary to prevent, respond to or alleviate the effects of an emergency or a disaster (*BC Emergency Program Act, 1996, Section 13(1)*).

Flooding is included as one of the water-related hazards under the *BC Emergency Program Act*, 1996.

Diking Authorities

As of June 1998, 90 Diking Authorities own and operate public diking systems in British Columbia. Under common law, and in accordance with relevant legislation and/or other agreements, the responsibility for operation and maintenance, including inspection and emergency response, is with these organizations.

The *BC Dike Maintenance Act* is the legislation that covers the operation and maintenance of public dikes. Other legislation relative to public dikes include, the *BC Drainage, Ditch and Dike Act* and the *BC Municipal Act*. The *Municipal Act* allows municipalities to undertake diking and drainage through local by-laws and improvement districts.

All Diking Authorities must have a flood response plan and this plan should be integrated with the Local Authority emergency response plan.

Provincial Agencies

Under the *BC Emergency Program Act* 1996, the Ministry of Transportation and Highways (MOTH) is identified as the key ministry for floods, and is responsible for coordinating the provincial government's response to floods. As such, MOTH has developed emergency plans and procedures that set out the manner in which

and the means by which the government will respond to the hazard. This is the *BC Flood Plan*, April 1998

Under the *BC Emergency Program Act*, the Ministry of Attorney General (MAG) and the Ministry of Environment, Lands and Parks (MELP) are identified as the main support ministries for floods, and are responsible to provide services, in cooperation with MOTH. Other support ministries/crown corporations include: Agriculture, Fisheries and Food, Finance and Corporate Relations, Forests, Government Services, Health, Municipal Affairs, Social Services, BC Ferry Corporations, BC Hydro/BC Rail, BC Systems, BC Transit, and BC Buildings.

Federal Government

The Emergency Preparedness Canada (EPC) is the federal agency responsible for flood planning and response. Its mission is to safeguard lives and reduce damage to property by fostering better preparedness for all emergencies in Canada.

The Emergency Preparedness Act (Canada), provides legislation for civil emergency preparedness, and related cooperation between federal and provincial/territorial governments. *The Emergencies Act* (Canada) enables the federal government to provide for safety and security of Canadians during national emergencies, including public welfare emergencies, public order emergencies, international emergencies, and war.

The *Federal Policy for Emergencies* serves as a guide for the development of civil emergency preparedness plans within the federal government. The policy sets out the responsibilities of federal departments and agencies as they relate to emergency planning and response, and emphasizes close collaboration and co-operation among federal institutions, and between federal and provincial/territorial governments and municipal authorities. This collaboration and cooperation is a key role of EPC.

To fulfil its mission, EPC participates in a wide range of activities to ensure that Canada is prepared to deal with all types of emergencies. To support these activities

EPC maintains a small regional office in each provincial capital, that is intended to ensure the compatibility of federal planning efforts with the provinces and municipalities, and to facilitate joint exercises. The EPC regional offices also assist in identifying significant emergencies and coordinating emergency response and mitigating the effects.

EPC administers the Disaster Financial Assistance Arrangements. These arrangements are intended to assist the provincial/territorial governments where the cost of responding to a disaster is greater than the provincial/territorial government reasonably could be expected to bear.

EPC also administers the Joint Emergency Preparedness Program, through which the federal government, in consultation and cooperation with provincial/territorial governments, carries out or contributes to projects that encourage a reasonably uniform emergency response capability across Canada. This program involves resource commitments from the federal and provincial/territorial governments.

Non-governmental Organizations (NGOs)

NGO's, such as the Red Cross, St John's Ambulance, Salvation Army provide some forms of assistance during emergency events.

Sandbag Protection at Nicomen Island

Appendix B: FLOOD PLANNING AND RESPONSE TIPS

GENERAL

1. Information on Emergency Planning is available from the Provincial Emergency Program Local Authority Planning Guide (1996 Revision) and the Provincial Emergency Program webpage.

2. Consider the type of flood and potential damaging scenarios to estimate response resources and techniques as part of the planning exercise.

3. Flood response planning is particularly critical for areas protected by dikes as failure of these works can actually increase the hazard and threat to life.

4. Identify flood prone roads in advance and limit/prevent public access in flooded areas (most serious injuries and deaths from flooding are associated with vehicle use).

5. Ensure the flood response plan is documented with regularly updated contact lists and available to senior public officials (these events always occur when key personnel are on vacation, holiday weekend, etc.).

6. Inspect flood protection works, bridges, culverts, intakes and outlets, pipeline crossings well in advance of high flow periods to ensure they will not be damaged by erosion or high flood level.

7. Undertake advance measures in potentially high freshet years to protect essential public services such as water supplies, sewer services, etc.

8. Set priorities for deployment of flood response resources:
   - threat to life;
   - threat to infrastructure;
   - damage to property; and
   - damage to environment.

9. Don't take on more that you can handle! It may not always be realistic to prevent flooding. Other measures to reduce damage include evacuation, moving valuable goods, sandbagging, and temporary water barriers.

10. Safety of the public and personnel is the Number 1 priority in any flood response.

FRESHET FLOODS - FLOOD PLANNING AND RESPONSE TIPS	
Affected Watercourses	All streams, lakes and rivers, particularly larger systems with snow accumulation
Timing	Generally in the spring. Larger systems tend to peak later in the season
Warning/Forecasting	Weather forecasts, Atmospheric Environment Service, MELP Snow Survey Bulletin
Characteristics	-rise and recede gradually -may be debris and accretion blockage -longer warning periods -potential for saturation of dike fill materials with subsequent piping and boiling occurring
Planning Tips	-identify floodprone areas, and safe areas -prepare a flood response plan -identify safe evacuation routes -work with the responsible Local Authority under the *Emergency Program Act* -may be able to plan for local sandbagging, temporary water barriers and debris interception
Special Hazards	-dike failure concerns for areas protected by dikes -internal drainage accumulation in low areas
Information	-floodplain maps may be available for larger streams -www.elp.gov.bc.ca/wat/flood/floodmgt.html

FLASH FLOODING - FLOOD PLANNING AND RESPONSE TIPS	
Affected Watercourse	Small to moderate streams and rivers
Timing	Coastal - fall/early winter Other - spring/summer rainstorms
Warning/Forecasting	Weather forecasts, Atmospheric Environment Service web page
Characteristics	-rise and recede rapidly -debris and accretion blockages along streams and at bridges/culverts can increase flood levels and erosive forces -little warning -may be high velocity on steep slopes -threat to life
Planning Tips	-identify potential blockage areas, erosion and avulsion paths -small streams can be confined to streets to reduce damages to development -no time for sandbagging, riprap and supplies must be stockpiled in the most critical areas -patrol critical blockage areas
Special Hazards	-avulsions on alluvial fans can create high velocity flows remote from channel -high erosion potential on steep streams -potentially very life threatening

DEBRIS FLOWS - FLOOD PLANNING AND RESPONSE TIPS	
Affected Watercourse	Generally smaller, steep streams on alluvial and colluvial fans
Timing	Coastal - during fall/ winter rains Other - spring/summer rainstorms
Warning/Forecasting	Weather forecasts, Atmospheric Environment Service, web page
Characteristics	-not generally predictable -rise and recede rapidly -debris and accretion blockages -little warning -high water velocity - threat to life
Planning Tips	-identify potential erosion and channel avulsion areas -small streams can be confined to streets to avoid damaging development -control of displaced water flow after a debris flow can limit damage
Special Hazards	-avulsions on alluvial fans can create high velocity flows remote from the channel -debris itself can cause significant damage in addition to water damage
Information	-see PART 2 - Flood Response Practices - Debris Flows

ICE JAM RELATED FLOODS - FLOOD PLANNING AND RESPONSE TIPS	
Affected Watercourse	Small to medium streams and rivers, e.g. Bulkley, Vedder, Nicola, Nechako
Timing	Can occur either during fall/winter freeze-up or spring snowmelt
Warning/Forecasting	Weather forecasts including conducive temperatures
Characteristics	-can occur rapidly, without much warning -water/ice rises and recedes rapidly -potential for erosion caused by ice push
Planning Tips	-identify potential ice jam areas based on past experience -blockages at bridges may be critical -may be able to break up with mechanical equipment
Special Hazards	-floating ice floes may be carried well outside the stream channel -release of ice jam may cause sudden flood flows
Information	-see PART 2 - Flood Response Practices - Ice Jams

BLOCKAGE RELATED FLOODS - FLOOD PLANNING AND RESPONSE TIPS	
Affected Watercourse	Smaller to moderate streams and rivers
Timing	Coastal - fall/ winter rains Other - spring/summer rainstorms
Warning/Forecasting	Weather forecasts, Atmospheric Environment Service web page
Characteristics	-rise and recede rapidly -unpredictable, caused by snow/ice, debris and landslides
Planning Tips	-identify potential blockage areas and avulsion paths -small streams can be confined to streets to avoid damaging development -regular patrol of critical areas, bridges/ culverts, intakes/outlets, is necessary -mechanical equipment is required to clear the blockage
Special Hazards	-avulsions on alluvial fans can create high velocity flows remote from channel -life threatening -damage to critical structures, bridges/ culverts, intakes/outlets is possible
Information	

STORM SURGE FLOODS - FLOOD PLANNING AND RESPONSE TIPS	
Affected Watercourse	Low coastal areas exposed to high/storm tides and high winds/waves
Timing	Most common during the winter, at the yearly high tide, around winter equinox
Warning/Forecasting	Weather forecasts, Atmospheric Environment Service, tide tables
Characteristics	-combination of high tides, low barometric pressure, wind set-up and high waves and runup -rise and recede rapidly, during the tidal period -limited warning available
Planning Tips	-identify areas with storm surge potential -communicate to community
Special Hazards	-vessels, docks, tanks can become floating hazards
Information	

Storm surge and waves - West Vancouver 1982

TSUNAMIS - FLOOD PLANNING AND RESPONSE TIPS	
Affected Watercourse	Outer coast, particularly along inlets and deep fjords
Timing	Anytime, generally remote earthquake generated
Warning/Forecasting	Weather forecasts, Atmospheric Environment Service, BC Tsunami Warning Plan, Provincial Emergency Program, police, local broadcasts
Characteristics	-rapid decrease followed by rapidly rising coastal waters well beyond normal sea levels -a tsunami will not be locally evident until it has arrived -the public must be informed
Planning Tips	-rapid evacuation of low lying coastal areas (less than 6 hours - dependant on epicentre) -identify safe evacuation routes well in advance and inform public -communicate to community
Special Hazards	-floating debris -vessels, docks, tanks, cars can become floating hazards
Information	-BC Tsunami Warning Plan (see Provincial Emergency Program website) -BC Tel telephone books - Tsunami and Earthquake information -see PART 2 - Flood Response Practices - Tsunamis

Appendix C: EMERGENCY (FLOOD) RESPONSE ORGANIZATION TYPES

The Emergency (Flooding) Response can be organized in several different ways. The Incident Command System is recommended for use by the provincial government. The Flood Plan and the MELP Water Related Hazards Response Plan are examples of this system. Alternatively a Departmental Organization or an Emergency Operations Centre structure may be used. The following pages briefly describe the Incident Command System and the Department Organization.

The Emergency Operations Centre structure is described in PART 1, Section 3.2.3.

INCIDENT COMMAND SYSTEM TYPE

Incident Command System

MELP employs the Incident Command System (ICS) as the response organization for water related hazard response, and for flooding follows the *BC Flood Plan, April 1998* which uses a modified ICS terminology.

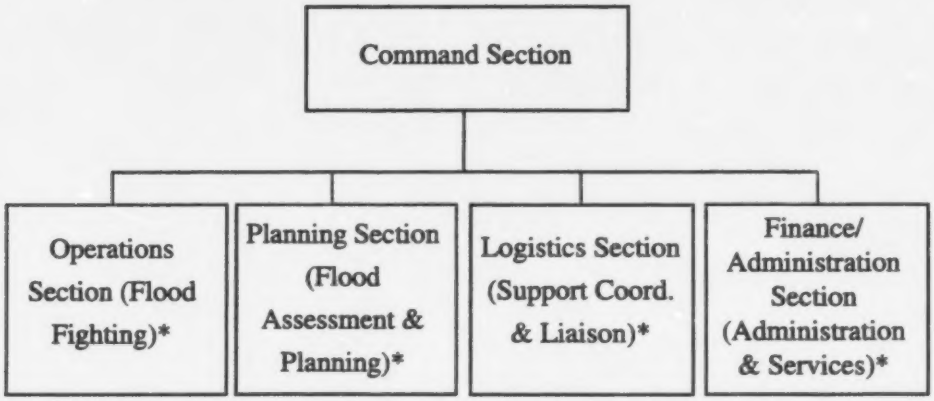
The ICS allows for the timely combination of resources and manpower during an emergency and promotes communication among responders. The ICS is applicable to all scales of hazards or other emergencies, is capable of expanding to meet an escalating situation, and accommodates multiple responding agencies (ie joint command operations).

ICS Organization

The ICS organization is comprised of five functional sections: Command, Operations, Planning, Logistics, and Finance. In the event of a water related hazard event, these functional sections are supported by units with specific responsibilities.

Only those ICS positions required for safe and effective response need to be invoked for any particular emergency situation. In a smaller scale emergency, a single person often does handle all of the functions, at least for a limited period of time. The same is true even of a larger scale emergency at the initial stage of activation and mobilization. As the response expands to meet the requirements of the emergency, a person is assigned to each component section, and then that person gains additional personnel who are assigned individual functional responsibilities as their sections become more active.

Incident Command System


Command Section
Operations Section (Flood Fighting)*
Planning Section (Flood Assessment & Planning)*
Logistics Section (Support Coord. & Liaison)*
Finance/ Administration Section (Administration & Services)*

Note: *ICS nomenclature with *BC Flood Plan* terminology in (brackets).

Command Section

This section provides incident command to ensure an effective, coordinated and cooperative response to the hazard event. The Command Section is responsible for management of the incident either as a single or unified command. The latter pertains to joint operations with other responders with functional or jurisdictional responsibilities such as local governments. The Command Section is comprised of the Incident Commander, the Deputy Commander, Information Officer, Safety Officer, Enforcement Officer and Liaison Officer.

Operations Section (Flood Fighting)

This section assists in the formulation of initial response strategy, and undertakes hazard response according to work plans and other tactical operations approved by the Command Section. The Operations Section determines the response equipment, contract services and field crews required to fulfil operation objectives. The Chief of Operations reports to the Incident Commander, as well as recommends expedient changes to the work plans and other tactical matters based on changing field conditions. The Section monitors contractors for compliance with safety requirements.

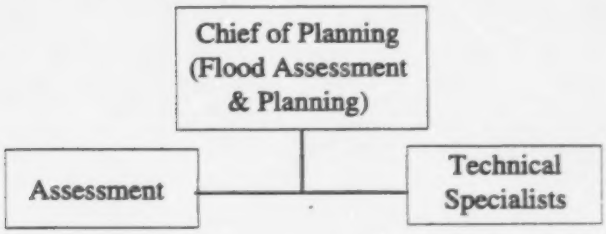
Planning Section (Flood Assessment & Planning)

This section identifies hazard response priorities and methods and liaises with other agencies, and communities to exchange information. The Planning Section undertakes the collection, evaluation, maintenance and storage of information required for and obtained during the hazard event. This information is used by the Section to prepare hazard response work plans.

The Section is comprised of different units and specialized field teams. The Assessment Unit gathers information, analyses the information, prepares reports and maps, and undertakes assessments. The Technical Specialist Unit is composed of relevant specialists which could include geotechnical, hydrological, dam safety, dike safety, river processes, habitat, hazardous materials or other types as required by the hazard event (see figure on following page).

Planning Section

(Flood Assessment & Planning)*
MELP Roles



Note: * ICS nomenclature with *BC Flood Plan* terminology in (brackets).

Logistics Section (Support Coord. & Liaison)

The Logistics Section is responsible for providing facilities, services and materials in support of the hazard response. The Section works in conjunction with other ministries to establish the field centres for response coordination, public information, wildlife rescue, medical, equipment staging, and other supporting facilities and services. The Chief of Logistics will assist in the development of the initial response strategy.

The Section will expedite equipment and service contracts and formulates contract specifications according to the work plans or other action requirements identified by the Incident Commander. The Logistics Section is comprised of three units: Support and Services; Medical; and Communications.

Finance Section (Administration & Services)

The Finance Section is responsible for providing financial and administrative support for the hazard response. To ensure cost recovery, the Finance Section is also responsible for documenting services, contract, and wage expenditures, as well as equipment losses and depreciation. The Section works closely with Logistics Section to ensure adequate record keeping and transactions. The Finance Section consists of two units: Administration and Finance; and Documentation and Cost Recovery.

DEPARTMENTAL ORGANIZATION TYPE

The Department Organization is based on a Local Authority departmental structure where each existing department performs specific flood response functions.

Reporting to the Mayor and Council of the Local Authority or the _____ of the Diking Authority, the Emergency Coordinator (Flood Response) will establish the Emergency Operations Centre (Flood Response) and direct the activities of the reporting groups.

Emergency Coordinator (Flood Response)

Responsible for overall direction and coordination of the flood response organization. Reports to the Mayor and Council of the Local Authority or the _____ of the Diking Authority, and liases with provincial and other emergency personnel.

Area Supervisors (Flood Response)

Responsible for all work in a specified flood response area. Responsible for apprising Local Authority and Diking Authority personnel and volunteer labour of safety procedures associated with flood response work. Each area will have a headquarters and report centre established in a suitable location. These centres may be established at a central location where such shared accommodation is beneficial.

Engineering Operations

Responsible for provision of heavy equipment, trucks, materials, water and sewer services, and allocation of Local Authority and Diking Authority personnel, and coordinating work requested by Area Supervisors (Flood Response). Coordination of outside utility services, a dispatch centre and engineering services.

Engineering Services

Responsible for provision of survey and drafting services, plans and water level records.

Human Resources

Responsible for pre-registration of volunteer labour, coordination with senior government Manpower and Employment Centres for other labour, and supplying such labour as requested by the Area Supervisors and/or Engineering Operations.

Dispatch Centre

Responsible for receiving and dispatching radio and telephone messages to and from the various Area Supervisors, affected property owners, and other Local Authority and Diking Authority personnel. Maintains records of all requests and queries and dispatches of men, material and equipment. Refers media and general information requests to the Information Centre.

Accounting Services

Responsible for the coordination and cost accounting for the various groups and to ensure that invoices, claims and other accounts are substantiated, and to assist in establishing and maintaining a cost control system.

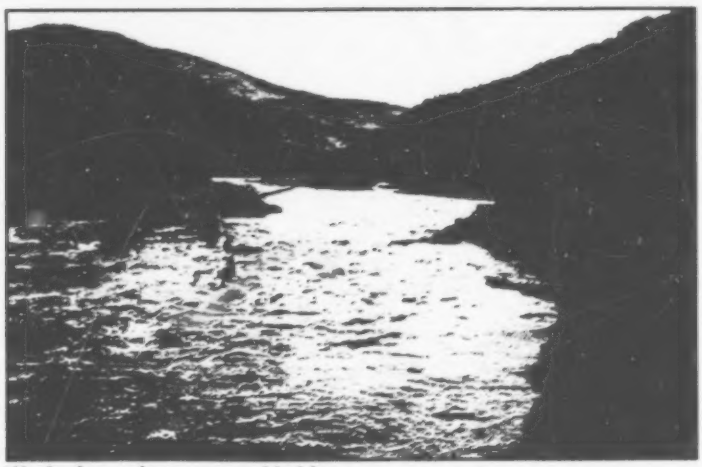
Information Centre and Public Relations

Responsible for responding to all general queries from citizens, and for providing information to the media. Arranges for announcements and notices authorized by the Flood Coordinator, or by the Mayor.

Post Flood Clean up and Restoration

Responsible for planning for clean up, return of evacuees, checking safety of flooded buildings (structurally, electrically, hygienically) and other utility connections (water, sewer, gas, etc).

Notes



Washed out abutment and bridge

FLOOD PLANNING AND RESPONSE GUIDE FOR BRITISH COLUMBIA

Part 2 - Flood Response

Introduction To Part 2 - Flood Response

PART 1 - FLOOD PLANNING describes the process for the Local Authority or Diking Authority to prepare a local flood response plan. By following that process, and using the information in this part, the Template and the Flood Response Information, the preparation of a local flood plan will be expedited.

The **Flood Response Template** will facilitate completion of the local flood response plan by a Local Authority or a Diking Authority. The Template follows the process outlined in the *Local Authority Planning Guide (1996 Revision)*.

The Template allows the Local Authority or Diking Authority to 'fill in the blanks' with regard to the particular local circumstances. Information or requirements which are not necessary may be omitted. Additional information can of course be included at the discretion of the Local Authority or Diking Authority.

The **Supplementary Plan** and **Flood Response Information** that follows the Template has been prepared for use in the local flood response plan as the particular local circumstances dictate. Many of the typical flood situations and information for this province have been included. All or any of the information should be included in the local plan as appropriate. Additional information can of course also be included as appropriate.

This guide is intended to promote advance planning, share available information and lead the reader to further flood planning and response practices. The guide is necessarily generalized and the applicability of the approaches discussed need to be evaluated and applied on a site specific basis.

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LOCAL FLOOD RESPONSE

PLAN TEMPLATE

Local Flood Response Plan Template

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Introduction

This flood response plan has been prepared for monitoring and responding to emergency conditions arising from high water levels on the _____ River(s), under the Local Authority emergency response plan, or as a stand alone document for the Diking Authority. The plan considers a variety of stages and is triggered by information provided by the Local Authority/Diking Authority, and/or the Provincial Government, principally the Snow Bulletins issued by the Ministry of Environment, Lands and Parks.

Aim

The aim of the plan is to prevent loss of life, and to minimize damage to and loss of property resulting from flooding due to high water levels on the _____ River(s).

Plan Implementation Phases

PHASE I - Pre Flooding Activities

The implementation of the Flood Response Plan may be triggered by observed rising water, snow survey reports, weather forecasts, and/or Provincial Government reports. The Emergency Coordinator (Flood Response) alerts the Emergency Operations Group (Flood Response), and the Group commences implementing the Flood Response Plan, reviews resources, assigns personnel, and meets with other Emergency Coordinating bodies. Preliminary inspection and familiarization tours of diking areas are undertaken, and remedial works required are identified and undertaken in preparation for projected water levels.

PHASE II - Rising Water

Based on specific water levels and/or warnings. Weekly patrols of dikes and key works are implemented. Some flooding in unprotected areas may occur, but effects at this level are negligible.

PHASE III - Limited Flooding

Based on specific water levels and/or warnings. Daily dike patrols are implemented. Limited flooding only of the following unprotected areas: _____.

PHASE IV - Increasing Flooding

Based on specific water levels and/or warnings. Daily dike patrols are continued, and augmented if necessary should conditions dictate. Increased flooding of unprotected areas such as _____, with flooding of the following roads: _____. Deployment of forces to mark roads, respond to requests as required.

PHASE V - Severe Flooding

Based on specific water levels and/or warnings. Dike patrols are assigned on a 24 hour basis. Much flooding of unprotected areas such as _____, with water levels exerting forces on existing dikes. Deployment of forces to mark roads, institute detours as required, assist residents and reinforce dikes, control boils, and other works as required.

Organization

The Emergency Response (Flooding) organization may be organized in any of several ways. The Incident Command System is recommended for use by the provincial government and the Ministry of Environment, Lands and Parks Water Related Hazards Response plan is an example of this system. The *BC Flood Plan* uses a modified ICS system. Alternatively a Local Authority departmental structure, where each existing department performs specific flood response functions, may be used. See PART 1 - FLOOD PLANNING, Appendix D for more details of both these organizational types.

The following organization is based on the Emergency Operations Centre structure used in PART 1 - FLOOD PLANNING and as described in the *Local Authority Planning Guide (1996 Revision).*

Reporting to the Mayor and Council of the Local Authority or the _____ of the Diking Authority, the Emergency Operations Group will establish the Emergency Operations Centre (Flood Response) and direct the activities of the reporting groups.

Emergency Notification System

Upon receipt of a warning of a real or potential emergency, the responding department will immediately contact the Police Force to request that the notification system be activated.

Upon receipt of the warning, the Police will notify all members of the Municipal Emergency Operations Group.

Upon being notified, it is the responsibility of all officials to notify their staff and volunteer organizations. Where a threat of an impending emergency exists, they will be notified and placed on standby.

An Emergency Notification List and Emergency Public Information Plan is shown in the Supplementary Plan Information section.

Action Prior To Implementation Of The Plan

When a flood hazard exists, employees should take such action(s) as required to protect lives and property in the Local Authority/Diking Authority area.

Emergency Operations Centre (EOC)

The Municipal Emergency Operations Group will report to the Emergency Operations Centre (EOC), located at the Local Authority/Diking Authority Office on _____ Street. In the event this operations centre cannot be used, then the secondary location will be the Local Authority Fire Department at _____ Road.

The layout and equipment of the Emergency Operations Centre are detailed in the *Local Authority Planning Guide (1996 Revision).*

Municipal Emergency Operations Group

The flood hazard response will be directed and controlled by officials who are responsible for providing the essential services necessary to minimize the effects of an emergency on the municipality.

This group is known as the Municipal Emergency Operations Group (you may wish to call it by another name) which consists of the following officials:

(a) Council Member of the Local Authority or alternate;
(b) Chief Administrative Officer, or alternate;
(c) Chief of Police, or alternate;
(d) Fire Chief, or alternate;
(e) Senior Public Works Officer, or alternate;
(f) Senior Emergency Health Officer, or alternate;
(g) Emergency Social Services Officer, or alternate;
(h) The Emergency Coordinator (Operations Officer);
(i) Public Information Officer; and
(j) Others.

Additional personnel called or added to the Municipal Emergency Operations Group may include:

(a) a representative of hydro;
(b) liaison staff from the Provincial Emergency Program, or another provincial ministry;
(c) any other officials, experts or representatives deemed necessary by the Municipal Emergency Operations Group.

The Municipal Emergency Operations Group may function with only a limited number of persons depending upon the emergency. While the Municipal Emergency Operations Group may not require the presence of all the people listed as members of the control group, all members of the Municipal Emergency Operations Group must be notified.

Business Cycle

Members of the Municipal Emergency Operations Group will gather at regular intervals to inform each other of actions taken and problems encountered. Frequency of meetings and agenda items will be established by the Operations Officer, who normally might be the emergency coordinator. Meetings will be kept as brief as possible thus allowing members to carry out their individual responsibilities. Maps and status boards will be prominently displayed and kept up to date by the Operations Officer.

Responsibilities

The organizational responsibilities are described in the Supplementary Plan Information section and follow those detailed in the *Local Authority Planning Guide (1996 Revision)*. Other hazard response organization types which the Local Authority or Diking Authority may wish to utilize are described in PART 1 - FLOOD PLANNING - Appendix C.

Plan Maintenance and Review

This plan will be reviewed annually and, where necessary, revised by a meeting(s) of the Municipal Emergency Planning Committee.

It is the responsibility of each person, agency, service or department named within this emergency plan to notify the Chief Administrative Officer forthwith, of any revisions or administrative changes. The Chief Administrative Officer should then provide a copy of the plan with all revisions to the Provincial Emergency Program Regional Manager.

General Operations

The designated head of each group will be responsible for preparing a detailed plan for that group's area of responsibility, conforming to the policies and procedures established

by the Mayor and Council (or Board). The various plans are to be coordinated by the Emergency Coordinator (Flood Response).

Requests for assistance beyond the scope of a particular group's responsibility or resources are to be routed through the Emergency Operations Centre. The EOC and Flood Coordinators will maintain an up to date picture of the overall situation and, if necessary, resolve necessary priorities in the allocation of resources.

Implementation

Annual Review of Plan	by March 31 each year
Annual Inspection of Flood Protection Works	by April 15 each year
"Test" Plan (conduct exercise)	Annually
Implement as required by circumstances.	As required

Authority

This local flood response plan is authorized under the *Emergency Program Act* or Bylaw #_____ of the Local Authority, or under Resolution #_____ of the Diking Authority.

Authorized Signature(s)_____

Date(s)_____

Additional Information

A plan can have as many parts as necessary.

Supplementary Plan Information
Notification and Public Information
Organizational Responsibilities
Plan Information such as maps, preparations, instructions, etc.
Relevant Information such as safety, historical water levels, snowpack, dike patrol, etc.
Resources such as owned or rental resources, communications, certifications, etc.
Procedures such as utility, gas, hydro, etc.

Flood Response Information
Safety Related Information
Inspections and Patrols
Flood Response Practices

Supporting information on these topics can be found on the following pages.

Flood Response Plan Distribution List

NAME	ORGANIZATION	ADDRESS	PHONE NUMBER

SUPPLEMENTARY PLAN INFORMATION

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Emergency Notification List

Mayor: Joe Bloggs
(O) 123-4567
(R) 123-8910

Alternate: Sally Smith
(O) 123-2748
(R) 123-8731
Car 345-2286

Chief Administrative Officer:
Jane Brown 567-8910

Alternate:
Tom Jones 998-7654

The list continues, listing all members of the Municipal Emergency Operations Group (Flood Response) and their alternates. All telephone numbers should be included - home, work, fax, cottage, car, pager, etc.)

1. The notification may be activated by the Chief Administrative Officer, the Emergency Coordinator (Flood Response), the Fire Chief, the Delegated Senior Police Officer or the Senior Public Works Officer.
2. Upon activation, the notification process will be carried out at once by the police dispatcher, who will note the detail of the message to be passed (e.g. description of the emergency, instructions to remain on stand-by or assemble at the Emergency Operations Centre (EOC), etc.). This dispatcher will ensure this information is passed to and understood by each person called.
3. Persons on the notification list will be called in order, starting with the Mayor.
4. If the primary person cannot be reached at any of the listed numbers, telephone the alternate.
5. If neither can be reached, go on to the next appointment on the list.
6. Once the end of the list has been reached, try again to reach those who were not available on the first attempt.
7. Note the exact time each person was reached.

Emergency Public Information Plan

Upon implementation of the flood response plan, it will be very important to coordinate the release of accurate information to the news media, issue authoritative instructions to the public, and respond to or redirect individual requests for, or reports on, information concerning any aspect of the emergency.

In order to fulfill these functions during an emergency, the following positions will be established:

(a) a Public Information Officer, and
(b) an On-Scene Media Spokesperson.

The media information centre will be located in the Dogwood Recreation Centre, 12 Church Street. In the event that this centre cannot be used, the secondary location will be the Oddfellows Hall, 11 Tower Road. (These locations are next door to the primary and alternate Emergency Operations Centre (EOC) locations. Both locations have been equipped with extra telephone jacks for emergency use.)

Depending on the nature of the emergency, it may be necessary to establish a media information area adjacent to the emergency site. This area, if established will be staffed by a site media spokesperson appointed by the Emergency Coordinator.

Public Information Officer

The Public Information Officer reports to the Chief Administrative Officer and is responsible for:

(a) Upon arrival at the Emergency Operations Centre (EOC), reporting to the Chief Administrative Officer to be briefed on the emergency situation.
(b) Establishing a communication link with the site media spokesperson, and any other media coordinators) (i.e. provincial, federal, private industry, etc.) involved in the incident, and ensuring that all information released to the media and public is consistent and accurate.
(c) Ensuring that the media centre is set up and staffed.
(d) Liaison with the Municipal Emergency Operations Group to obtain up-to-date information for media releases, coordinate individual interviews and organize press conferences.
(e) Ensuring that the following are advised of the telephone number of the media centre:
    - Media
    - Municipal Emergency Operations Group
    - Switchboard (Municipal and Emergency Services)
    - Site Media Spokesperson
    - Police Public Relations Officer Neighbouring Municipalities

- Any other appropriate persons, agencies or businesses

(f) Ensuring that the media releases are approved by the Chief Administrative Officer (in consultation with the Mayor) prior to dissemination, and distributing hard copies of the media release to the Public Information Centre, the Municipal Emergency Operations Group, and other key persons handling inquiries from the media.

(g) Monitoring news coverage, and correcting any erroneous information.

(h) Maintaining copies of media releases and newspaper articles pertaining to the emergency.

Site Media Spokesperson

The site media spokesperson will be appointed by the Emergency Coordinator and is responsible for:

(a) Establishing and coordinating a media information centre in a safe, appropriate location, at or near the site, for the media to assemble.

(b) Establishing a communication link and regular liaison with the Public Information Officer at the Emergency Operations Centre (EOC).

(c) Redirecting all inquiries regarding decisions made by the Municipal Emergency Operations Group and the emergency as a whole, to the Public Information Officer.

(d) Advising the following persons and agencies of the location and telephone number(s) (as available) of the Site Media Information Centre:

- Emergency Coordinator
- Police Public Relations Officer
- Emergency services personnel at scene (where possible)
- Public Information Officer(s)
- Media

(e) Ensuring that media arriving at the site are directed to the site information centre.

(f) Where necessary and appropriate, coordinating media photograph sessions at the scene.

(g) Coordinating on-scene interviews between the emergency services personnel and the media.

Organizational Responsibilities

This organizational structure follows that detailed in the *Local Authority Planning Guide (1996 Revision)*. Other hazard response organization types which the Local Authority or Diking Authority may wish to use are described in PART 1 - FLOOD PLANNING - Appendix C.

Emergency Operations Group Responsibilities

The actions or decisions which the members of the Municipal Emergency Operations Group are likely to be responsible for are:

(a) Calling out and mobilizing their emergency service, agency and equipment.
(b) Coordinating and directing their service and ensuring that any action necessary for the mitigation of the effects of the emergency are taken, provided they are not contrary to law.
(c) Determining if the location and composition of the Municipal Emergency Operations Group are appropriate.
(d) Advising the Mayor as to whether a major emergency exists, and/or whether it is necessary to declare a State of Local Emergency under the *BC Emergency Program Act (1996)* for all, or part of the town.
(e) Ensuring that an Emergency Coordinator (EC) is appointed.
(f) Discontinuing utilities or services provided by public or private concerns, i.e. hydro, water, gas, closing down a shopping plaza/mall.
(g) Arranging for services and equipment from local agencies not under municipal control, i.e., private contractors, volunteer agencies, service clubs.
(h) Notifying, requesting assistance from the Provincial Emergency Program and any public or private agencies not under municipal control, as considered necessary.
(i) Determining if additional volunteers are required and if appeals for volunteers are warranted.
(j) Determining if additional transport is required for evacuation or transport of persons and/or supplies.
(k) Ensuring that pertinent information regarding the emergency is promptly forwarded to the Public Information Officer, for dissemination to the media and public on a regular basis.
(l) Determining the need to establish advisory group(s) and/or sub-committees.
(m) Authorizing expenditure of money required to deal with the emergency.
(n) Notifying the service, agency or group under their direction, of the termination of the emergency.
(o) Maintaining a log outlining decisions made and actions taken, and submitting a summary of the log to the Chief Administrative Officer within one week of the termination of the emergency, as required.
(p) Participating in the debriefing following the emergency.

Chief Administrative Officer

(a) Activating the emergency notification system through the Local Authority Police Force.
(b) Advising the Mayor on policies and procedures, as appropriate.
(c) Approving, in conjunction with the Mayor, major announcements and media releases prepared by the Public Information officer, in consultation with the Municipal Emergency Operations Group.
(d) Ensuring that a communications link is established between the Municipal Emergency Operations Group and the Emergency Coordinator (EC).
(e) Calling out additional municipal staff to provide assistance as required.

Delegated Senior Police Officer

(a) Activating the emergency notification system, and ensuring all members of the Municipal Emergency Operations Group are notified.
(b) Notification of necessary emergency and municipal services, as required.
(c) The establishment of a site command post with communications to the EOC.
(d) Establishing an ongoing communications link with the senior police official at the scene of the emergency.
(e) The establishment of an inner perimeter within the emergency area.
(f) Establishment of an outer perimeter in the vicinity of the emergency to facilitate movement of emergency vehicles and restrict access to essential emergency personnel.
(g) The provision of traffic control to facilitate the movement of emergency vehicles.
(h) Alerting persons endangered by the emergency and coordinating evacuation procedures.
(i) Liaison with the Emergency Social Services Director regarding the establishment and operation of evacuation and reception centres.
(j) The protection of life and property and the provision of law and order.
(k) The provision of police service in evacuee centres, morgues, and other facilities, as required.
(l) Notifying the coroner of fatalities.
(m) Liaison with other municipal, provincial and federal police agencies, as required.
(n) Providing an Emergency Coordinator if required.

Fire Chief

(a) Activating the emergency notification system through the Local Authority Police Force.
(b) Providing the Municipal Emergency Operations Group with information and advice on fire fighting and rescue matters.
(c) Establishing an ongoing communications link with the senior fire official at the scene of the emergency.
(d) Initiating mutual aid arrangements for the provision of additional fire fighting manpower and equipment, if needed.
(e) Determining if additional or special equipment is needed and recommending possible sources of supply, e.g. breathing apparatus, protective clothing, etc.

(f) Providing assistance to other municipal departments and agencies and being prepared to take charge of or contribute to non-fire fighting operations if necessary, e.g., rescue, first aid, casualty collection, evacuation, etc.
(g) Providing an Emergency Coordinator if required.

Senior Public Works Officer

(a) Activating the emergency notification system through the Local Authority Police Force.
(b) Providing the Municipal Emergency Operations Group with information and advice on engineering matters.
(c) Liaison with the senior public works officer from the neighbouring municipality(s) to ensure a coordinated response.
(d) The provision of engineering assistance.
(e) The construction, maintenance and repair of municipal roads.
(f) The maintenance of sanitary sewage and water systems.
(g) The provision of equipment for emergency pumping operations.
(h) Liaison with the fire chief concerning emergency water supplies for fire fighting purposes.
(i) The provision of emergency potable water, supplies and sanitation facilities to the requirements of the Medical Health Officer.
(j) Discontinuing any public works service or utility to any consumer, as required, and restoring these services when appropriate.
(k) Liaison with public utilities to disconnect any service representing a hazard and/or to arrange for the provision of alternate services or functions,
(1) Providing public works vehicles and equipment as required by any other emergency services.
(m) Maintaining liaison with flood control, conservation and environmental agencies and being prepared to take preventative action.
(n) Providing an Emergency Coordinator if required.

Emergency Medical Health Representative

(The selection of the Emergency Medical Health Representative will vary between communities. Normally only one health representative is a member of the Municipal Emergency Operations Group and it can be the Medical Health Officer, a hospital administrator, or someone from the ambulance service.)

The Emergency Medical Health Representative is responsible for:

(a) Acting as a coordinating link for all emergency health services at the Municipal Emergency Operations Group.
(b) Liaison with the Ministry of Health.
(c) Liaison with the ambulance service representatives.
(d) Providing advice on any matters which may adversely affect public health.

(e) Providing authoritative instructions on health and safety matters to the public through the Public Information Officer.
(f) Coordinating the response to disease-related emergencies or anticipated emergencies such as epidemics, according to Ministry of Health policies.
(g) Ensuring coordination of care of bedridden citizens and invalids at home and in evacuee centres during an emergency.
(h) Ensuring liaison with voluntary and private agencies, as required, for augmenting and coordinating public health resources.
(i) Ensuring coordination of all efforts to prevent and control the spread of disease during an emergency. Notifying the Senior Public Works Officer regarding the need for potable water supplies and sanitation facilities.
(k) Liaison with the Emergency Social Services Director on areas of mutual concern regarding health services in evacuee centres.

Emergency Coordinator

(a) Coordinating all operations within the Emergency Operations Centre, including the scheduling of regular meetings.

Emergency Social Services Director

(a) Ensuring the well-being of residents who have been displaced from their homes by arranging emergency lodging, clothing, feeding, registration and inquiry and personal services.
(b) Supervising the opening and operation of temporary and/or long term evacuee centres, and ensuring they are adequately staffed.
(c) Liaison with the Delegated Senior Police Officer with respect to the predesignation of evacuee centres which can be opened an short notice.
(d) Liaison with the Emergency Medical Health Officer on areas of mutual concern regarding operations in evacuee centres.
(e) Ensuring that the representatives of School Board(s) is/are notified when facility(s) is/are required as evacuee reception centre(s) and that staff and volunteers utilizing the school facility(s) take direction from the Board representatives with respect to its/ their maintenance, use and operation.
(f) Liaison with _____ Home for the Aged and Acme Nursing Home as required.

Support and Advisory Staff

The following staff may be required to provide support, logistics and advice to the Municipal Emergency Operations Group:

(a) Deputy or Assistant Administrative Officer
(b) Property Manager
(c) Legal Services Officer
(d) Treasurer

(e) Purchasing Officer
(f) Human Resources Officer
(g) Transportation Officer
(h) Communications Officer
(i) Representatives of business and industry

Many Local Authorities and Diking Authorities do not have staff members in these positions on a full-time basis. In that case, provision should be made within the emergency plan to ensure that the functions are assigned to someone - a trained volunteer perhaps. Individual Support Staff Responsibilities could be:

Assistant Administrative Officer

(a) Assisting the Senior Administrative Officer, as required.
(b) Ensuring all important decisions made and actions taken by the Municipal Emergency Operations Group are recorded.
(c) Upon direction from the Senior Administrative Officer, notifying the required support and advisory staff of the emergency, and the location of the Emergency Operations Centre.
(d) Initiating the opening, operation and staffing of the switchboard at the municipal offices, as the situation dictates, and ensuring operators are informed of Municipal Emergency Operation members' telephone numbers in the Emergency Operations Centre (EOC).
(e) Arranging for printing of material, as required.
(f) Coordinating the provision of clerical staff to assist in the Emergency Operations Centre (EOC), as required.
(g) Upon direction by the Mayor, arranging a special meeting(s) of council, as required, and advising members of council of the time, date, and location of the meeting.
(h) Procuring staff to assist, as required.

Property Manager

(a) Opening and maintaining the municipal offices.
(b) Providing security for the municipal offices, as required.
(c) Providing identification cards to Municipal Emergency Operations Group members and support staff.
(d) Coordinating the maintenance and operation of feeding, sleeping and meeting areas at the Emergency Operations Centre (EOC), as required.
(e) Procuring staff to assist, as required.

Legal Services Officer

(a) The provision of advice to any member of the Municipal Emergency Operations Group on matters of a legal nature as they may apply to the actions of the Local Authority in its response to the emergency, as requested.

Treasurer

(a) The provision of information and advice on financial matters as they relate to the emergency.
(b) Liaison, if necessary, with the Treasurer(s) of neighbouring municipalities.
(c) Ensuring that records of expenses are maintained for future claim purposes.
(d) Ensuring the prompt payment and settlement of all the legitimate invoices and claims incurred during an emergency.

Purchasing Officer

(a) The provision and securing of equipment and supplies not owned by the Local Authority.
(b) Liaison with purchasing agents of the neighbouring municipalities, if necessary.
(c) Maintaining and updating a list of all vendors (including 24-hour contact numbers) who may be required to provide supplies and equipment.

Human Resources Officer

(a) Coordinating and processing requests for human resources.
(b) Under the direction of the Municipal Emergency Operations Group, coordinating offers of, and appeals for, volunteers.
(c) Selecting the most appropriate site(s) for the registration of human resources.
(d) Ensuring records of human resources and administrative detail, that may involve financial liability, are completed.
(e) When volunteers are involved, ensuring that a Volunteer Registration Form is completed, and a copy of the form is retained for municipal records.
(f) Ensuring identification cards are issued to volunteers and temporary employees, where practical.
(g) Arranging for transportation of human resources to and from site(s).
(h) Obtaining assistance, if necessary, from Employment and Immigration Canada, as well as other from government departments, public and private agencies and volunteer groups.

Transportation Officer

(a) Coordinating the acquisition, distribution and scheduling of various modes of transport (i.e. public transit, school buses, trains, boats, and trucks) for the purpose of transporting persons and/or supplies, as required, by members of the Municipal Emergency Operations Group and the support and advisory staff.
(b) Procuring staff to assist, as required.
(c) Ensuring that a record is maintained of drivers and operators involved.

Communications Officer

(a) Activating the emergency notification system of the local amateur radio operators group.
(b) Initiating the necessary action to ensure the telephone system at the municipal offices function as effectively as possible, as the situation dictates.
(c) Ensuring that the emergency communications centre is properly equipped and staffed and working to correct any problems which may arise.
(d) Maintaining an inventory of municipal and private sector communications equipment and facilities within the municipality which could, in an emergency, be used to augment existing communications systems.
(e) Making arrangements to acquire additional communications resources during an emergency.

Public Information Officer

Few Local Authorities and Diking Authorities have a full-time public information officer. Someone must be selected in advance to fill this role in an emergency. This person can be a municipal employee or an elected official. They can be from the police or fire department, but in this case it must be clear that their only emergency responsibility is public information.

The Public Information Officer is responsible for the dissemination of news and information to the media and the public. An example public information plan is shown in the previous section.

Other Agencies

In an emergency, many agencies may be required to work with the Municipal Emergency Operations Group. Two such agencies are detailed below. Others might include the Office of the Fire Commissioner, industry, volunteer groups, conservation authorities, and provincial ministries. Detail on the agreed arrangements made in advance with such agencies should be included in this section of the plan.

School Boards

(a) The provision of any school (as appropriate and available) for use as an evacuation or reception centre.

(b) Upon being contacted by the Emergency Social Services Director or designate, providing a School Board(s) representative(s) to coordinate and provide direction with respect to the maintenance, use and operation of the facilities being utilized as evacuation or reception centres.

(c) In the event of an emergency during normal school hours, the principal(s) of the affected school(s) (until directed otherwise) is/are responsible for:

  (i) implementing the school Emergency Plan, or

  (ii) implementing the school Evacuation Plan, as advised by the Municipal Emergency Operations Group, depending on the nature and scope of the emergency.

Hospital Administrator

(a) Implementing the hospital emergency plan.

(b) Liaison with the Emergency Medical Health Representative and local ambulance representatives with respect to hospital and medical matters, as required.

(c) Evaluating requests for the provision of medical site teams/medical triage teams.

(d) Liaison with the Ministry of Health, as appropriate.

Relevant Plan Information

Map(s)

Showing Flood Response Area
including

Areas Protected By Dikes, Areas Not Protected By Dikes, Flood Prone Areas, Dike Protection Boundary, Dike Pump Station, Bridges, Utility Crossings, Dams, Other Structures, Evacuation Routes, etc.

Instructions To Area Supervisors

EXAMPLE

1. Limits of their patrol - be aware of geographical boundaries and features of dikes.
2. Stay on duty until relieved.
3. How to contact headquarters - personnel to be familiar, with communications equipment and procedures.
4. Fill out inspection log.
5. Mark with stakes all problem areas and, if they appear dangerous, immediately report to headquarters.

EQUIPMENT TO PROVIDE TO AREA SUPERVISORS:

1. All-weather clothing.
2. Radio for communications to headquarters.
3. Flashlight for night patrols.
4. Long wooden stakes and red flagging.
5. Round-nose shovel.

FLOOD FIGHT OPERATIONS
BASIC SAFETY TIPS FOR PATROL CREWS

- Workers must be reminded to wash their hands before eating or drinking. Bacteria can be rampant in flood waters and this simple step can go a long way in reducing the threat of an outbreak of waterbome disease.

- For similar reasons, all injuries should receive prompt first aid and care to reduce the risk of infection. Anyone who is injured must be instructed to review the need for a tetanus booster with their personal physician or other medical authority. Even minor cuts and scrapes can provide an entry path for tetanus germs.

- To reduce cuts and scrapes, gloves must be worn while doing heavy work. While leather or heavy gloves are best, almost any pair of gloves will provide some degree of hand protection.

- Skin creams and lotions can be used to moisturize and protect skin. The skin, particularly on the hands, can become dry and cracked after being exposed to water and other harsh field conditions, Dry, cracked, and broken skin can lead to infections and other problems. The application of a good protective and moisturizing skin cream every several hours can significantly reduce this problem.

- Some functions may require special protective equipment. Provisions must be made to issue specialized safety gear to volunteers and other workers. Hard hats may be necessary, particularly around machinery or in areas where loading equipment is being used. Ear protection shall be required around extremely noisy equipment. In some communities patrols are provided life jackets and vests.

- All workers must be reminded never to walk behind construction machinery or heavy equipment.

It is extremely dangerous to walk or drive in flooded areas. The flood waters can lift manhole covers and expose unseen, water filled shafts. It may be impossible to rescue someone who has fallen into an unprotected water filled sewer or utility shaft. Persons who are forced to walk in flooded areas must be instructed to use a walking stick or pole to probe for unseen dangers and the use of life jackets is recommended.

Workers must also be advised to avoid areas subject to collapse, such as areas next to inundated foundation walls. The weight of the person on water saturated ground may be enough to cause the basement or foundation walls to cave in.

Flood Response Organization And Personnel

POSITION	NAME	PHONE	ALTERNATE	PHONE

History Of Water Levels On The _____ River
(Lake, Creek, Etc.)

YEAR	DATE	HEIGHT

Provincial Snowpack And Flow Reports

(Insert relevant information here.)

Dike Patrol Log

(Insert relevant information here.)

Flood Protection Information For The _____ Area(s)

(Separate section for each area)

(Include dikes, erosion protection and other works)

Checklists Of ICS Functions

REGIONAL FUNCTIONS

Safety and General Functions - for all Personnel

Incident Commander (Sector Commander)
- **Deputy Commander** (Deputy Sector Commander)
- **Information Officer**
- **Safety Officer**

Chief of Operations (Flood Fighting Chief)
- **Operations Functions**

Chief of Planning (Flood Assessment and Planning Chief)
- **Planning Functions**
- **Technical Specialist Functions**

Chief of Logistics (Support Coordination and Liaison Chief)
- **Logistics Functions**

Chief of Finance (Administration and Services Chief)
- **Finance Functions**

Supervisor / Team Leaders (if required)

Only those ICS positions required for a safe and effective response need to be invoked for any particular emergency situation. Depending on the scope and nature of the situation certain supervisory and leader roles may not be invoked.

In a smaller scale emergency, a single person often does handle all of the functions, at least for a limited period of time. The same is true even of a larger scale emergency at the initial stage of activation and mobilization. As the response expands to meet the requirements of the emergency, a person is assigned to each component section, and then that person gains additional personnel who are assigned individual functional responsibilities as their sections become more active.

NOTE: ICS nomenclature with BC Flood Plan terminology in (brackets).

Reference: ***MELP Water Related Hazards Emergency Response Plan and Procedures, 1998.***

Safety and General Functions - for all Personnel

It is the responsibility of supervisors to ensure that safety of response personnel is of the highest priority. All new response personnel arriving on the scene must be briefed on safety matters and informed of unsafe situations. Hazard response work has an "A" Hazard Classification under the *Workers' Compensation Act* (WCA). Safety requirements must be organized according to the requirements of the Occupational Health and Safety Regulations, and are dependent on the number of workers per shift and the travel time to the nearest hospital.

Ideally, response personnel should work in teams of two in the field, and must have ready access to communications (phone, receivers). Operations under night, or very severe weather, conditions should be carefully considered. The well-being of **personnel working alone** must be checked in accordance with WCA requirements. Checks should be made at such intervals and by such means as are appropriate to the nature, hazard and circumstances of the employment.

Personnel Requirements

In a small emergency, a single person might handle all of the functions for a limited period of time. The same is true even of a larger emergency at the initial stage of activation and mobilization. As the response expands to meet the requirements of a larger emergency, a person is assigned to each component branch, and then that person gains additional personnel who are assigned individual functional responsibilities as their cells become more active.

The response must function on a continuous, 24/7 basis from activation until de-activation. The manner in which this is done is at the discretion of the Chief of Planning (Flood Assessment and Planning Chief). While the immediate solution may be to establish several complete shifts for the duration of operations, there are seldom resources or facilities to sustain this approach. Plans should call up two complete shifts for an initial period of time, after which reduced-strength options can be considered for implementation on a branch by branch basis, such as:

- Duty Officer(s) - a reduced staff of one or two persons handles all incidents affecting the branch. This system might require several days experience or some preliminary training, but it is particularly useful during periods of reduced activity.

- Reduced Staffing - the branch staff work longer shifts or with fewer people than would be attempted in order to provide relief to some others. This is appropriate to allow short breaks for meals, etc. Reduced staffing can also be used to permit other staff activities to occur, such as VIP briefing or a field visit.

- Partial Stand-down - a branch or section within a branch may be left unmanned temporarily to suit reduced activity levels. This approach may be possible during night hours when supported (or supporting) functional organizations cannot operate, and as response operations come to an imminent end.

Other Considerations

a. Staff Rest: Time must be allowed for rest, meals, ablutions, etc. The matter cannot be "left to sort itself out". Schedules must follow the Hours of Work Provisions in the *Employment Standards Act*, especially section 39, **No excessive hours.**

b. Labour Relations: Rules and regulations regarding safety and over-time, etc. are not suspended on account of the emergency.

c. Briefings, Conferences: Activities at the PFRC which require all staff to attend should be infrequent. They interrupt necessary rest time and can preclude such necessary events as field visits.

Safety and General Functions - for all Personnel

The following are general instructions applicable to all MELP Hazard Response Personnel.

- ☐ Determine re-assignment of priority office work and arrange personal/home matters.
- ☐ Acquire work material and safety gear required for field work.
- ☐ Determine initial location and staging areas and means of transportation.
- ☐ Report to assigned location (Provincial Field Response Centre, Command Post, Staging Area) and obtain situation briefing and assignments.
- ☐ Identify supervisor and obtain all necessary safety/survival equipment and procedures.
- ☐ Ensure arrival and location recorded by supervisor.
- ☐ Obtain checklists of respective functions.
- ☐ Obtain appropriate forms for field operations.
- ☐ Identify and brief subordinates on situation, safety, reporting relationship and functions.
- ☐ Maintain personal log of activities and hours worked.
- ☐ Check out with supervisor on completion of functions and/or end of shift.

The following are Checklists of Functions for hazard response. The checklists are intended to facilitate completion of actions prior to leaving the office and upon arrival in the field. The functions outlined in the checklists are presented in sequential order, allowing the person using it to follow and build on their responsibilities.

Incident Commander Functions
(Sector Commander in the BC Flood Plan)

Mission: Command of the response personnel to ensure an effective, coordinated and cooperative response.

Location: Provincial Field Response Centre

Functions:

- ☐ Obtain initial incident briefing from field assessment personnel (PEP & MELP).
- ☐ Assess the situation and establish the action strategy.
- ☐ Conduct briefings of command staff and section chiefs.
- ☐ Delegate functions to the Sector personnel.
- ☐ Ensure coordination of reconnaissance.
- ☐ Ensure planning meetings are conducted.
- ☐ Establish and approve priorities.
- ☐ Approve and authorize implementation of incident action plans.
- ☐ Manage incident operations.
- ☐ Approve requests for additional resources and requests for release of resources.
- ☐ Approve the use of volunteers, registered through the local government and PEP.
- ☐ Ensure effective operation of the PFRC and overall operations.
- ☐ Coordinate Command staff and Section Chief activities.
- ☐ Ensure all affected agencies and resource agencies have been notified.
- ☐ Authorize the release of information to the news media or the public.
- ☐ Ensure Sector Status summary is completed and provided to the PECC.
- ☐ Prepare Sector Briefing Form for the succeeding Incident Commander.
- ☐ Issue tasking directives.

Deputy Commander Functions
(Deputy Sector Commander in the BC Flood Plan)

Mission: Assist the Incident Commander by way of initiation of response strategies, response team coordination and communication.

Location: Provincial Field Response Centre

Functions:

- ☐ Ensure effective operation of the PFRC.
- ☐ Ensure briefing to the PECC.
- ☐ Ensure effective PFRC operation.
- ☐ Ensure effective action plans for Incident Commander.
- ☐ Ensure all affected agencies have been contacted (INAC, CN/CP, etc.).
- ☐ Ensure resource agencies are identified (Coast Guard, DFO, etc.), and contacted.
- ☐ Coordinate reconnaissance.
- ☐ Perform Incident Commander's functions in his/her absence.
- ☐ Assist the Incident Commander with his/her functions.

Information Officer Functions
(This position is filled as required
depending on the scope of the hazard response)

Mission: Provides the main contact with media and the public to ensure that accurate, timely and consistent information is being provided on the event and the response activities.

Location: Provincial Field Response Centre

Functions:

- ☐ Obtain situation briefing from Incident Commander.
- ☐ Coordinate public information activities of all ministries.
- ☐ Establish a media centre in proximity to the PFRC.
- ☐ Obtain copies of current Status Summary from Incident Commander.
- ☐ Prepare information summary fact sheets.
- ☐ Issue Public Information bulletins as requeste d by the Incident Commander.
- ☐ Attend meetings to update information releases.
- ☐ Provide escort service to the media and senior government personnel.
- ☐ Respond to special requests for information.
- ☐ Maintain log of inquiries and incident status report.

Safety Officer Functions
(This position is filled as required
depending on the scope of the hazard response)

Mission: Monitors and assesses hazardous or unsafe situations and develops measures for assuring personnel safety, as well as undertakes whatever steps to prevent or stop unsafe acts.

Location: Provincial Field Response Centre or Command Post

Functions:

- ☐ Report to supervisor for situation briefing.
- ☐ Identify obvious hazards and unsafe situations that might need to be addressed.
- ☐ Ensure an adequate number of qualified first aid personnel, safety equipment and Ambulance Services will be on-site to meet *Workers' Compensation Act* requirements.
- ☐ Ensure response activities are being monitored for safety compliance.
- ☐ Monitor familiarization of auxiliary personnel and volunteers to field equipment and safety. (volunteers are registered through the local government and PEP)
- ☐ Ensure unsafe practices and all injuries are reported to the Incident Commander and that a mechanism of stop-orders are in place.

Chief of Operations Functions
(Flood Fighting Chief in the BC Flood Plan)

Mission: Provides assistance in the preparation of the response strategy and determines the requirements for equipment, contract services and field crews.

Location: Provincial Field Response Centre

Functions:

- ☐ Obtain briefing from Incident Commander.
- ☐ Develop operations portions of Action Plan.
- ☐ Brief and assign operations personnel in accordance with Action Plans.
- ☐ Brief Incident Commander and Chief of Planning.
- ☐ Determine equipment and human resource needs and allocation and request additional resources.
- ☐ Together with Chief of Planning, make recommendations on priority of operations.
- ☐ Report information about special activities, events and occurrences to Incident Commander.
- ☐ Ensure response activities are monitored for effectiveness and safety.
- ☐ Coordinate response activities for dam and dike protection and repair to watercourses and drainages.
- ☐ Coordinate repairs to roadways and bridges.
- ☐ Assemble and supervise field crews.
- ☐ Ensure field crews provided with safety materials and equipment, transportation, communications, etc.
- ☐ Supervise contractors and auxiliary personnel hired.
- ☐ Identify obvious hazards and unsafe situations that might need to be addressed.
- ☐ Ensure an adequate number of qualified first aid personnel, safety equipment and Ambulance Services will be on-site to meet *Workers' Compensation Act* requirements.
- ☐ Ensure response activities are being monitored for safety compliance.
- ☐ Monitor familiarization of personnel to field equipment and safety.
- ☐ Ensure unsafe practices and all injuries are reported and that a mechanism of stop-orders are in place.
- ☐ Ensure permanent records are kept of operations including time and costs.

Operations Functions
(Flood Fighting in the BC Flood Plan)

Mission: Provides operations services, such as hazard response (flood fighting).

Location: Field Crew Staging Area/Field Locations

Functions:

- ☐ Report to Chief of Operations or supervisor for situation briefing.
- ☐ Obtain appropriate information and materials (forms, maps, briefcases, etc.).
- ☐ Arrange for transportation, communications and safety equipment.
- ☐ Obtain briefing on functions and safety matters.
- ☐ Undertake operations functions.
- ☐ Provide on-site construction supervision, supervise contractors and auxiliary personnel hired.
- ☐ Review activities for effectiveness and safety.
- ☐ Notify the supervisor of critical situations that threaten people, infrastructure (roads, communications and utilities), property or the environment.
- ☐ Maintain a record of work accomplished and personal/equipment work hours.
- ☐ Identify obvious hazards and unsafe situations that might need to be addressed.
- ☐ Report unsafe practices and any injuries.

Chief of Planning Functions
(Flood Assessment and Planning Chief in the BC Flood Plan)

Mission: Recommends response action priorities to the Incident Commander and collects, evaluates, disseminates information obtained from field assessment.

Location: Provincial Field Response Centre

Functions:

- ☐ Undertake advance planning including assembly of information, maps, reports, assessment forms, and assignment of staff.
- ☐ Obtain briefing from Incident Commander.
- ☐ Liaise with River Forecast Centre and provide local forecasts.
- ☐ Assign assessment personnel to PFRC as appropriate.
- ☐ Determine priorities and set schedules for site surveys/inspections.
- ☐ Review and update field reports.
- ☐ Determine level of protection needed for priority areas at risk.
- ☐ Together with Chief of Operations, assess and recommend priorities for action plan.
- ☐ Assemble information on alternative response strategies and make recommendations.
- ☐ Identify need for use of specialized expertise/resource(s) for planning and operations, including dike safety, dam safety, river process, worksite, geotechnical, etc.
- ☐ Provide information to the Information Officer.
- ☐ Ensure transportation, safety equipment, tools and supplies available for teams.
- ☐ Coordinate special tasks as assigned by the Incident Commander.
- ☐ Ensure an adequate number of qualified first aid personnel, safety equipment and Ambulance Services will be on-site to meet *Workers' Compensation Act* requirements and a stop work mechanism is in place.
- ☐ Ensure activities are being monitored for safety compliance and unsafe practices and activities are reported.
- ☐ Monitor familiarization of personnel to field equipment and safety.
- ☐ Ensure permanent records are kept of assessments, hours of work, etc.
- ☐ Brief Incident Commander and Chief of Operations.

Planning Functions
(Flood Assessment and Planning in the BC Flood Plan)

Mission: Conduct field surveys for the systematic collection of information, prepare documentation, advise on response techniques, and monitor response efforts.

Location: Field Crew Staging Area/Field Locations

Functions:

- ☐ Report to Chief of Planning or supervisor for situation briefing and assist in identifying areas and facilities at risk.
- ☐ Obtain filed reports, maps and data forms for assessments.
- ☐ Obtain appropriate Assessment Forms and tools (flagging, tape measure, marking pen, camera, binoculars, etc.).
- ☐ Arrange with supervisor for site transportation and safety equipment for site assessment reconnaissance (hard hat, safety vest, boots, etc.).
- ☐ Assemble with assessment team members and supervisor to delineate functions, to schedule field deployment, to review data collection procedures and to establish safety procedures.
- ☐ Undertake assessment functions including site assessments, gauge reading, advice on design and construction techniques (seepage, boils, erosion, sloughing, etc.).
- ☐ Fill out an Assessment Form for each site assessment and forward to supervisor.
- ☐ Review field data obtained and prepare maps and plans as required.
- ☐ Notify supervisor of any critical situations that threaten people, infrastructure (roads, communications and utilities), property or the environment.
- ☐ Maintain a record of work accomplished and personal hours worked.
- ☐ Identify obvious hazards and unsafe situations that might need to be addressed.
- ☐ Report unsafe practices and any injuries.

Technical Specialist Functions
(These positions are filled as required
depending on the scope of the hazard response)

Mission: Provides specialist assessment services including dike safety, dam safety, river process, worksite, geotechnical, construction, etc.

Location: Field Crew Staging Area/Field Locations

Functions:

- ☐ Report to the Chief of Planning (Flood Assessment and Planning Chief) for situation briefing and assist in identifying areas and facilities at risk.
- ☐ Obtain filed reports, maps and data forms for assessments.
- ☐ Obtain appropriate Assessment Forms and tools (flagging, tape measure, marking pen, etc.).
- ☐ Arrange with supervisor for site transportation and safety equipment for site assessment reconnaissance.
- ☐ As required, assemble with assessment team members and supervisor to delineate functions, to schedule field deployment, to review data collection procedures and to establish safety procedures.
- ☐ Undertake specialist assessment functions in coordination with Assessment Teams and dam/dike owners as required.
- ☐ Prepare and provide Assessment Forms and other documentation to supervisor.
- ☐ Review field data obtained and prepare Maps and Operational Plans.
- ☐ Prepare risk analysis and advice.
- ☐ Notify supervisor of any critical hazard situations that threaten people, infrastructure (roads, communications and utilities), property or the environment.
- ☐ Maintain a record of work accomplished and personal work hours.

Chief of Logistics Functions
(Support Coordination and Liaison Chief in the BC Flood Plan)

Mission: Provides the coordination of other ministry's activities in support of the PFRC operations whereby additional resources are sought by the Incident Commander. Arranges and provides facilities, services, personnel and materials.

Location: Provincial Field Response Centre

Functions:

- ☐ Obtain briefing from Incident Commander.
- ☐ Assign work locations and preliminary work tasks to section personnel.
- ☐ Keep a record of units activated including names and locations of assigned personnel.
- ☐ Participate in preparation of Action Plan.
- ☐ Review Action Plan and estimate needs for next operation period.
- ☐ Assess response equipment and personnel needs.
- ☐ Coordinate requests for additional resources identified by Incident Commander not available within the PFRC structure.
- ☐ Coordinate support elements of the Action Plan.
- ☐ Coordinate notification and liaise with community to inform and address hazard concerns.
- ☐ Coordinate local community efforts with the Provincial response.
- ☐ Arrange volunteer services.
- ☐ Establish Command Post and field communications as required.
- ☐ Ensure other agencies provide evacuation services and health services.
- ☐ Ensure liaison with traffic control.
- ☐ Co-ordinate with livestock protection and evacuation services.
- ☐ Liaise with Chiefs of the ICS sections and Commander.
- ☐ Arrange for transportation and accommodation of response personnel.
- ☐ Maintain inventory, costs and records of equipment deployed/returned.

Logistics Functions
(This position is filled as required
depending on the scope of the hazard response)

Mission: Arranges and provides facilities, services, personnel and material.

Location: Provincial Field Response Centre/Command Post

Functions:

- ☐ Report to the Chief of Logistics (Support Coordination and Liaison Chief) and obtain briefing.
- ☐ Determine types of response equipment needed.
- ☐ Establish a Command Post, if required, and field communications in proximity to area.
- ☐ Assess future equipment and personnel requirements.
- ☐ Liaise with Finance Officer.
- ☐ Distribute and record equipment issued.
- ☐ Arrange for transportation and accommodation.
- ☐ Maintain inventory and cost records of equipment deployed and returned.

Chief of Finance Functions
(Administration and Services Chief in the BC Flood Plan)

Mission: Provides administration and financial services to the Incident Commander as may be required on a 24 hour basis, including billing, accounting, filing, invoicing and preparation of service contracts.

Location: Provincial Field Response Centre

Functions:

- ☐ Review Action Plan and estimate PFRC needs for next operation period.
- ☐ Identify service and support requirements for PFRC operation.
- ☐ Establish and maintain a filing system for PFRC staff.
- ☐ Prepare summary sheets of cumulative resource deployment.
- ☐ Ensure all PFRC obligation documents initiated at the incident are properly prepared and completed.
- ☐ Prepare and consolidate time and wage records for the PFRC.
- ☐ Provision of PFRC facilities including a large meeting room (20 persons), a small meeting briefing room (6 persons) and a media centre.
- ☐ Ensure adequate facilities are provided to house the PFRC.
- ☐ Ensure access security and services are provided on a 24 hour basis (keys, coffee, food, etc.).
- ☐ Provide sufficient telephones and communications for PFRC operations.
- ☐ Ensure clerical services, stationary and supplies are available to support the PFRC.
- ☐ Maintain financial control and records of PFRC expenditures and commitments.
- ☐ Acquire emergency materials and maintain records.
- ☐ Arrange accommodation and travel for PFRC staff.
- ☐ Provide radio communication to the PFRC.
- ☐ Ensure adequate courier and message service available on a 24 hour basis.

Finance Functions
(This position is filled as required
depending on the scope of the hazard response)

Mission: Provides for the overall administrative and finance services which include billing, accounting, filing and invoicing and preparation of service contracts.

Location: Provincial Field Response Centre/Command Post

Functions:

- ☐ Report to and obtain briefing from the Chief of Finance (Administration and Services).
- ☐ Obtain stationary, office equipment supplies and clerical support for response personnel.
- ☐ Establish financial (cash accounts, invoices, billings, contracts, etc.) and administrative (filing, stationary supplies, etc.) capability for response.
- ☐ Assign support clerical staff, if needed, to support response efforts.
- ☐ Liaise with Logistics Officer for preparation of equipment and service contracts and rentals.
- ☐ Coordinate accounting for food, equipment, wages, accommodation, travel, etc.
- ☐ Prepare financial and administration status reports.

Supervisor/Team Leader Functions

(Position(s) filled as required
depending on the scope of the hazard response.)

Mission: Assumes supervisory role over Operations or Planning functions/teams as required.

Location: Command Post/Site Assessment Crew Staging Area

Functions:

- ☐ Report to Chief of Operations or Planning, or supervisor, for situation briefing and assist in identifying areas and facilities at risk.
- ☐ Assume delegated responsibilities from supervisor.
- ☐ Determine number and deployment of field crews.
- ☐ Determine resource allocations among multi-site activities.
- ☐ Secure site transportation and safety equipment for field crews/teams.
- ☐ Assemble field crews to delineate functions, schedule field deployment, to review data collection procedures and to establish safety procedures.
- ☐ Review activities for effectiveness and safety.
- ☐ Supervise contractors and auxiliary personnel hired.
- ☐ Identify obvious hazards and unsafe situations that might need to be addressed.
- ☐ Ensure response activities are being monitored for safety compliance.
- ☐ Monitor familiarization of personnel to field equipment and safety.
- ☐ Ensure unsafe practices and all injuries are reported and that a mechanism of stop-orders are in place.
- ☐ Ensure permanent records are kept of work accomplished, costs and hours worked.

Flood Response Plan Resources

Local Authority Equipment

TYPE	DRIVER	UNIT #	YEAR/ MAKE	G. V. W.	RADIO	MISC.

Local Contractors And Equipment

EQUIPMENT	CONTRACTOR	PHONE	CONTACT PERSON

Local Authority Stores And Services

TYPE	QUANTITY	LOCATION	CONTACT PERSON

Materials Available From Local Sources

ITEM	VENDOR	PHONE	CONTACT PERSON

Locally Available Rental Equipment

ITEM	VENDOR	PHONE	CONTACT PERSON

Local Authority Radios And Cellular Telephone Listing

PERSON	PHONE NO.	RADIO CALL SIGN	POSITION

First Aid Certification For Local Authority Employees

NAME	TYPE	DATE CERTIFIED

Flood Response Personnel Driving Information

NAME	D. L. CLASS	EQUIPMENT EXPERIENCE

Joint Occupational Health And Safety Committee Members

For Local Authority/Diking Authority

NAME	DEPARTMENT	PHONE NUMBER

Flood Response Plan Procedures

Local Authority Utility Operations Procedures

EXAMPLE

General Procedures for Flood Control

In the event that severe flooding should occur, the following measures will be taken:

1. In the event of severe flooding, close all air release valves,
2. Mark valves in event of breaking watermains, which may cause contamination,
3. Keep a close check on 88th Avenue Bridge, Fraser River Bridge, Fort Langley and 96th Avenue Salmon River Bridge to prevent a loss of water in case of bridge failure,
4. Check with City of _____ to get water at 196th Street and 96th Avenue in event of emergency,
5. Will have valve and hydrants checked and marked on map in flooding area,
6. Check 201st Street north of 96th Avenue P.R.V. station,
7. Check buried watermain crossing at Glover Road and Salmon River Bridge.

BC Gas Procedure

(Insert applicable procedures here.)

BC Hydro Procedure

(Insert applicable procedures here.)

Dam Safety Procedures

(If applicable)

(Insert applicable procedures here.)

Dike Safety Procedures

(If applicable)

(Insert applicable procedures here.)

FLOOD RESPONSE INFORMATION

Flood Response Information

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SAFETY RELATED INFORMATION

Safety Considerations

Safety requirements for flood response personnel must be carefully considered since the work involves exposure to hazardous conditions.

Great care should be taken if water is flowing over the ground surface. A minimum depth of flowing water can produce a large force on a human being.

Personnel Safety planning is required and includes:

- Personal Protective Equipment
- Safety Working Procedures:
  - Check in time
  - Communication equipment
  - Less experienced personnel should be accompanied by experienced person
  - Volunteer safety requirements must be met

The Workers' Compensation Board Regulations must be followed.

Safety Checklists (Example)

Safety and General Functions - for all Personnel

It is the responsibility of supervisors to ensure that safety of response personnel is of the highest priority. All new response personnel arriving on the scene must be briefed on safety matters and informed of unsafe situations. Hazard response work has an "A" Hazard Classification under the *Workers' Compensation Act* (WCA). Safety requirements must be organized according to the requirements of the Occupational Health and Safety Regulations, and are dependent on the number of workers per shift and the travel time to the nearest hospital.

Ideally, response personnel should work in teams of two in the field, and must have ready access to communications (phone, receivers). Operations under night, or very severe weather, conditions should be carefully considered. The well-being of **personnel working alone** must be checked in accordance with WCA requirements. Checks should be made at such intervals and by such means as are appropriate to the nature, hazard and circumstances of the employment.

Personnel Requirements

In a small emergency, a single person might handle all of the functions for a limited period of time. The same is true even of a larger emergency at the initial stage of activation and mobilization. As the response expands to meet the requirements of a larger emergency, a person is assigned to each component branch, and then that person gains additional personnel who are assigned individual functional responsibilities as their cells become more active.

The response must function on a continuous, 24/7 basis from activation until de-activation. The manner in which this is done is at the discretion of the Chief of Planning (Flood Assessment and Planning Chief). While the immediate solution may be to establish several complete shifts for the duration of operations, there are seldom resources or facilities to sustain this approach. Plans should call up two complete shifts for an initial period of time, after which reduced-strength options can be considered for implementation on a branch by branch basis, such as:

- Duty Officer(s) - a reduced staff of one or two persons handles all incidents affecting the branch. This system might require several days experience or some preliminary training, but it is particularly useful during periods of reduced activity.

- Reduced Staffing - the branch staff work longer shifts or with fewer people than would be attempted in order to provide relief to some others. This is appropriate to allow short breaks for meals, etc. Reduced staffing can also be used to permit other staff activities to occur, such as VIP briefing or a field visit.

- Partial Stand-down - a branch or section within a branch may be left unmanned temporarily to suit reduced activity levels. This approach may be possible during night hours when supported (or supporting) functional organizations cannot operate, and as response operations come to an imminent end.

Other Considerations

a. Staff Rest: Time must be allowed for rest, meals, ablutions, etc. The matter cannot be "left to sort itself out". Schedules must follow the Hours of Work Provisions in the *Employment Standards Act*, especially section 39, **No excessive hours**.

b. Labour Relations: Rules and regulations regarding safety and over-time, etc. are not suspended on account of the emergency.

c. Briefings, Conferences: Activities at the PFRC which require all staff to attend should be infrequent. They interrupt necessary rest time and can preclude such necessary events as field visits.

Safety and General Functions Checklist
- for all Personnel

The following are general instructions applicable to all MELP Hazard Response Personnel.

- ☐ Determine re-assignment of priority office work and arrange personal/home matters.
- ☐ Acquire work material and safety gear required for field work.
- ☐ Determine initial location and staging areas and means of transportation.
- ☐ Report to assigned location (Provincial Field Response Centre, Command Post, Staging Area) and obtain situation briefing and assignments.
- ☐ Identify supervisor and obtain all necessary safety/survival equipment and procedures.
- ☐ Ensure arrival and location recorded by supervisor.
- ☐ Obtain checklists of respective functions.
- ☐ Obtain appropriate forms for field operations.
- ☐ Identify and brief subordinates on situation, safety, reporting relationship and functions.
- ☐ Maintain personal log of activities and hours worked.
- ☐ Check out with supervisor on completion of functions and/or end of shift.

Reference: *MELP Water Related Hazards Emergency Response Plan and Procedures, 1998*

Vehicle Safety Equipment Checklist

LIST OF VEHICLE SAFETY EQUIPMENT (EXAMPLE)

1	FIRST AID KIT	2	TRAFFIC CONES
3	FLARES	1	FIRE EXTINGUISHER
1	REFLECTIVE VEST PER PERSON	1	FLOATING LIFELINE ROPE
2	BLANKETS	1	REFLECTIVE WARNING KIT
1	AUTOTEL RADIO OR EQUIVALENT	1	SHOVEL
1	FLASHLIGHT	1	TOOL BAG C/W TOOLS
1	STANDARD VEHICLE JACK	1	JACKALL JACK
1	SPARE TIRE	1	WHEEL WRENCH
1	SET WINTER TIRE CHAINS	1	SET JUMPER CABLES
1	AX OR SANDVICK	1	PACKAGE OF WATER-PROOF MATCHES
1	CANDLE (EMERGENCY HEAT SOURCE)	1	SEARCH LIGHT ((Plugs into cigarette lighter)
		1	SET OF PERSONAL SAFETY EQUIPMENT FOR EACH PERSON IN ACCORDANCE WITH WCB REGULATIONS

Great care should be taken if water is flowing over the roadway. A minimum depth of flowing water can produce a large force on a vehicle.

Flooding: How Can 0.3 to 0.6 metres of Water Cost You Your Life?

- **Nearly HALF of all flash flood fatalities are auto related!**
- **0.6 metres of water will carry away most automobiles!**

Notice to Residents (Example)

NOTICE TO RESIDENTS
ON POTENTIALLY HIGH RIVER LEVELS

(Date)

Dear Resident:

The Province of British Columbia, Ministry of Environment, Lands and Parks, has recently advised that normal snow melt in the mountain areas has been delayed due to cool temperatures and the runoff is three to four weeks late. A sudden prolonged warm spell will increase the risk of above average river levels and the potential risk of flooding. The Local Authority is monitoring the situation and will issue further notices as necessary.

Property Owners with river frontage and in low lying areas are responsible for taking the necessary precautions against the risk of flooding. Stockpiles of sand and sandbags are available at all fire halls. Delivery of sand and bags will be arranged by the Local Authority on a priority basis. Pamphlets on flood preparedness including a recommended method for sandbag diking are available from the Local Authority, B.C. Environment and the Provincial Emergency Program.

If further information is required please contact the Local Authority.

(Closing)

INSPECTIONS AND PATROLS

EXAMPLE

High Water Patrol Inspections

Patrol inspections should be carried out during high water events to monitor the performance of the flood control works and identify needed corrective actions.

During high water events, local water level gauges should be monitored regularly and the readings recorded for future reference. Dike patrol frequency should increase as flow and/ or water levels approach critical conditions, and should be continuous while the level is within about 1.0 m of the dike crest. The patrol crews are to observe and report to the diking authority any conditions or occurrences that could signal a weakening of the works such as:

- Seepage through the dike and at the landside toe of the dike. Close attention should be paid to seepage, as the safety of the dike can be threatened by an increase or concentration of seepage flows.
- Boiling. these are small up-wellings of clear running water caused by excessive seepage pressure and can appear at considerable distances inland from the dike.
- Piping. Seepage is generally considered to be normal provided flows are not excessive nor concentrated in the form of piping or boils. Piping is the physical transport of fill or foundation material by concentrated seepage flows; this can be identified either as suspended silts (murky water) or visible sand particles. The process results in progressive removal of material with an enlarging hole extending toward the river at an increasing rate. Eventually an open path is created and the dike may collapse and breach in an "explosive" manner. Piping is sometimes preceded by boils.
- Cables, utilities, pipes, floodboxes, etc. Structures that transverse the dike fill should be monitored for seepage and settlement.
- Relief wells. The rate, colour of flows and transport of particles from relief wells and internal drains should be monitored.
- Gullying. Observations should be made for sloughing and / or erosion of the dike slopes by gullying.
- Settlement of the dike crest and slopes causing ground depressions or sinkholes. Observations should particularly be made for possible differential settlement over floodboxes and structures in or through the dike.
- Areas of low freeboard due to variable river profile or loss of dike fill.

- Cracking of the dike crest or slopes.
- Erosion of the riverbank adjacent to the dike.
- Sloughing, erosion and/ or loss of rock from bank protection works. Critical areas should be closely inspected during and after high water events.
- Debris accumulation at floodboxes, flap gates and trash racks.
- Stream blockages or redirection of flows due to logs, debris, gravel and sediment, and/ or ice jams, especially near bridges or other constrictions.
- Pumps not operating properly.
- Dike patrol/inspection logs should be retained by the Diking Authority to record all inspections and actions taken, and also to serve as part of the performance record. Sample logs are provided.

Reference: *MELP Guidelines for Management of Flood Protection Works in BC, 1999*

Flood Protection Works Management Checklist

Diking Authority: _____

O&M Supervisor: _____ Tel: _____ Fax: _____

DIOD _____ Tel: _____ Fax: _____

Dike Name: _____

O&M Manual: Yes ❑ No ❑

Floodplain Management Bylaw: Yes ❑ No ❑

1. **Records:** Design Reports _____ Plans _____

   Files Nos. _____ Floodplain Maps _____

2. **Rights-of-way:** Yes ❑ No ❑

3. **Annual Budget/Taxes:** Yes ❑ No ❑

4. **Follow-up Last Inspection:** By: _____

   Annual Inspection (submit report to DIOD): Yes ❑ No ❑

5. **Approvals/Changes:** Yes ❑ No ❑

6. **Maintenance:**

	Required	Okay
Access:	❑	❑
gates	❑	❑
dike crest	❑	❑
Damages/Repairs:	❑	❑
dike	❑	❑
bank protection	❑	❑
floodboxes	❑	❑
pumps	❑	❑
drainage	❑	❑
Vegetation Control:	❑	❑
animal activity	❑	❑
debris	❑	❑

7. **Flood Response Plan:**

Flow Forecasting	❑	❑
Contact list	❑	❑
Materials	❑	❑
Equipment	❑	❑
Communications	❑	❑
Flood Patrol	❑	❑
Warning/Evacuation Plan	❑	❑

8. **Follow-up Action Complete:** Yes ❑ No ❑
(submit report to DIOD)

Date: _____ Signed: _____

10/07/98

Sheet No. _____
File No. _____

Flood Protection Inspection Report

Dike Length: _____

DIKE: _____

REACH: _____

DATE INSPECTED: _____ **Signed** _____

The condition of the flood protection works is as reported below:

1. **DIKES:** (access, gates, locks, vegetation growth, gravel surface, height, slopes, erosion, animal burrows, seepage, trash, berms, relief wells)

_____

_____

_____

_____

_____

_____

_____

2. **BANK PROTECTION:** (loss of rock, settlement, slumping)

_____

_____

_____

_____

_____

_____

_____

3. **FLOODBOXES/PUMP STATIONS**: (inlet and outlet channels, gate operation, trash racks, debris, erosion, corrosion, structure, discharge structure, electrical and mechanical components)

4. **WORK REQUIRED**:

5. **ADDITIONAL INFORMATION** (see over) (sketch, photos, etc.)

6. **WORK COMPLETED**: Date:_____ Signed:_____

April 7, 1999

Dike Patrol Log

Date: _____ Inspector: _____
Time Commenced: _____ Time Completed: _____

1. Gauge Height	Design WL	Time	Water Level
Gauge _____	_____	_____	_____
Gauge _____	_____	_____	_____

2. **Landside Seepage**
   - Boils Yes ❑ No ❑
   - Ponding Yes ❑ No ❑

3. **Landside Slope**
   - Cracking Yes ❑ No ❑
   - Sloughing Yes ❑ No ❑
   - Seepage Yes ❑ No ❑

4. **Dike Crest**
   - Accessible Yes ❑ No ❑
   - Cracking Yes ❑ No ❑
   - Settlement Yes ❑ No ❑
   - Freeboard

5. **Riverside Slope**
   - Erosion Yes ❑ No ❑
   - Instability Yes ❑ No ❑

6. **Floodboxes**
   - Gates Open ❑ Closed ❑

Pumps
- Inlet/Outlet
- Operating Yes ❑ No ❑

Comments/Location

Clear: Dirty: Piping: _____

Sinkholes: _____

Dike Fill: Riprap: _____

Leakage: Flow Estimate: _____

Open: Obstructed: _____

Flow Estimate: _____

8. **Required Action** _____

Notification: _____ **To Whom:** _____ **Time:** _____

Refer to System Operation & Maintenance Manual

Dike & River Assessment - Information Log

■ **SITE NUMBER:**_____

A Dike & River Assessment Form should be completed for each site showing a potential or actual dike failure or river problem. The Team Leader should complete the form and submit it to the Chief of Planning. Each form should be provided with a unique site number that corresponds with each problem area. The site should, in turn, be staked and flagged with this number to facilitate locating by field operations.

☐ **Dike Assessment** or ☐ **River Assessment**

Part I - Location and Access
Dyking or River System:_____
Description of dike section or river reach inspected (provide nearest landmark(s) and access information.
Use Site Location Map to facilitate locating section or reach.
_____
_____
_____

Site Location Map &/or Situation Sketch
N
↑

Part II - Supervisor / Inspector
Supervisor / Inspector:_____
First Last
Date:_____ Time (24 hr.) Started:_____ Finished:_____
d /m / y

Part III - Water Levels (Gauges)

River reach or Gauge: Name	Design Water Level or Flood Level (m)	Time (24 hr.)	High Watermark (m)

Water Level Change: ☐ Rising ☐ Falling ☐ Unknown
_____mm rise/fall over last one hour, _____mm rise/fall over last 24 hours,
_____mm rise/fall since last inspection; date/time of last inspection
Comments:_____
_____

Part IV - Assessment Check situation and circle problem. If more than one situation, number according to severity. Use Situation Sketch to assist in describing situation.

DIKE	RIVER
☐ Riverside (Erosion/Instability)	☐ Flooding
☐ Dike Crest (Settlement/Cracking/Access/Freeboard)	☐ Bank (Erosion, Overflow)
☐ Landside Slope(Seepage/Instability/Cracking)	☐ Debris Jam
☐ Flood Box (Gate Leaking)	☐ Public (Risk/Harm)
☐ Flood Box (Seepage)	☐ Property (Threat/Damage)
☐ Seepage (Boil, Ponding)	☐ Bridge & Abutment (Erosion/Debris Jam/Highwater)
☐ Internal Drainage	☐ Road or Causeway (Erosion/Highwater)
☐ Other: _____ Specify	☐ Other: _____ Specify

Comments:_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____
_____

Part V - Risk Evaluation Severity: High _____ Medium ___ Low _____
Risk to: ☐ people ☐ infrastructure ☐ property ☐ environment: _____
_____
_____

Part VI - Operation Requirements & Constraints
Operation requirements (sand bagging, rip-rapping, etc.) & operation constraints (access difficulty, heavy equipment limitations, etc.)
_____
_____
_____
_____
_____
_____
_____

Chief of Planning

Operation Priority:

High:_____ Med.:_____ Low_____

Authority: _____

Time:_____ Date:_____

FLOOD RESPONSE PRACTICES

DISCLAIMER

These practices are intended as information for the use of emergency planners. They are based on information available to the authors at the time of report preparation. These practices are not based on an exhaustive review of the literature, and are limited by the information available to the authors. Discussion of the practices cannot be considered an endorsement by the authors or sponsoring agencies of any particular technology or product. The authors and sponsoring agencies are not liable for any consequences arising from the use of the information in this document.

Actual methods and practices used will vary depending on site specific conditions.

Existing Dikes

Tips for Existing Dikes

- address remedial repairs prior to them becoming catastrophic
- inspect as necessary to identify failure mechanisms
- understand the dike construction methods
- classify the dikes and identify risks associated with different types (e.g. berms, engineered dikes, soil types, ownership)
- identify methods of response based on risk assessment or a particular form of failure
- consider that risks increase with continuing and successive flood peaks
- consider the rate of draw down and possible affects on dike stability
- consider wind effects on wave height and wave uprush

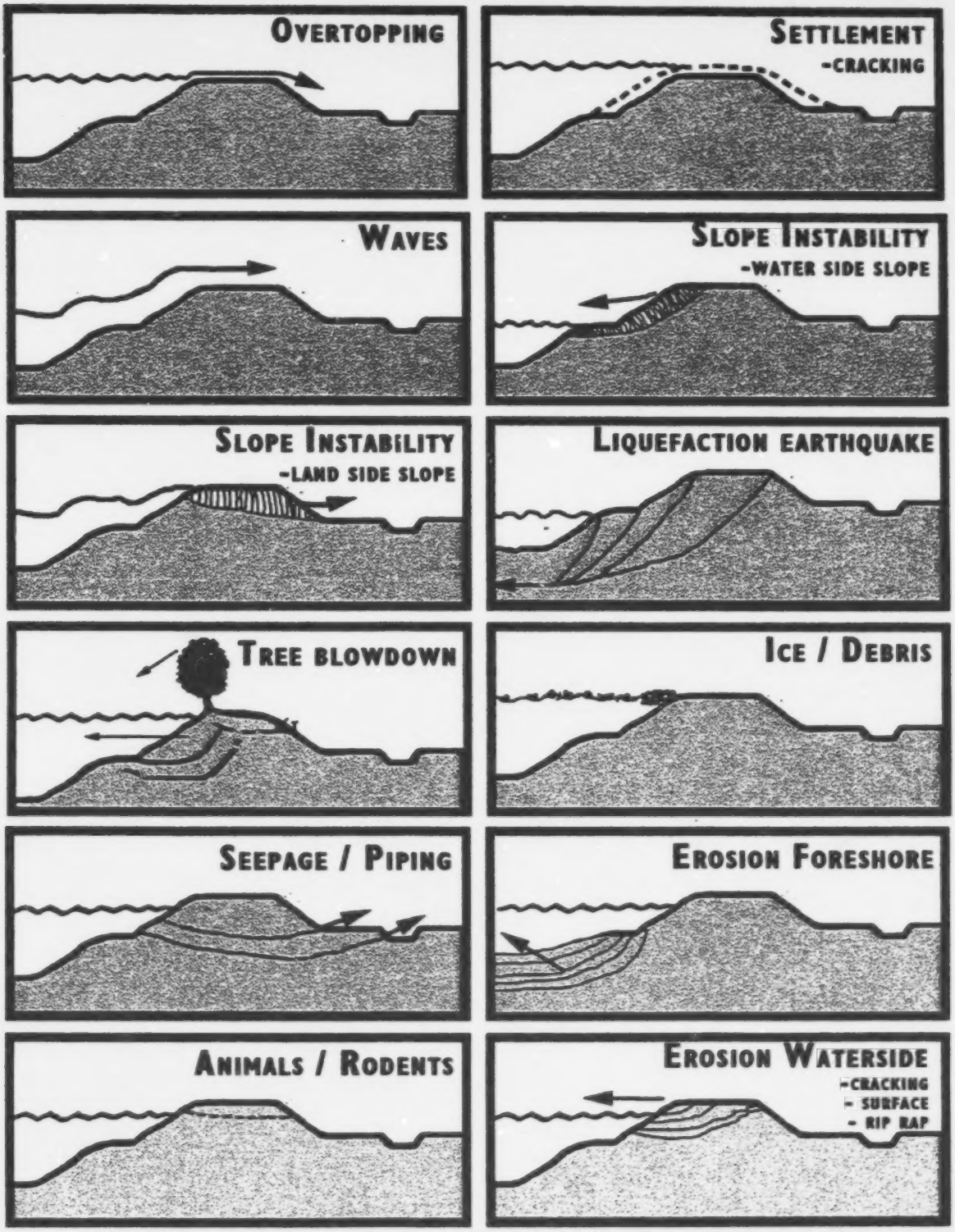
Failure Mechanisms

Dikes failure can occur in a number of ways and remedial practices are discussed in the following sections. Figure 1 on the next page illustrates the following failure mechanisms:

- overtopping
- waves
- settlement - cracking
- slope instability
    - landside slope
    - water side slope
- liquefaction - earthquake
- tree blowdown
- ice - debris
- seepage - piping
- animals
- erosion
    - foreshore
    - water side

Failure Mechanisms

Figure 1



Raising Existing Dikes (Local Overtopping)

Sandbagging Tips

- sandbagging may be employed for a number of failure mechanisms not just raising dikes
- filling sandbags in sufficient quantities requires extensive pre-planning (e.g. equipment, manpower, volunteers)
- check quality of bags prior to anticipated flooding
- attempt to identify quantity of sandbags needed
- provide training - demos, videos, on the job
- identify sources of sand
- identify location where sandbagging will take place - at sand source or transport sand
- ensure equipment is available for all aspects of sandbagging - transportation, filling, etc.
- ensure that team leaders manage the installation crews
- Abbotsford installs half round chutes at the back of dump trucks for rapid sandbag filling.

Preparation

- As the prediction of flood profiles is uncertain, and because dikes often have varying freeboard, patrols should be advised to pay close attention to lower than average freeboard.

- Once water flows over the dike crest, fill is usually rapidly washed away creating a breach. This generally increases in size and will not be practical to close until water levels equalize.

- Sandbags are usually considered for raising low sections of dike as shown in Figure 2. However, progress is slow and considerable hand labour is required. Sandbags should normally only be used for raising short sections of dike. Alternatives to sandbags include wire baskets or water dams and Flex-Mac (See Figure 3 and the Flood Response Resource Listing).

- Consider using the Windrow and Plastic Sheet method shown on Figure 4 to raise an existing dike up to 0.4 metres.

- Heavy equipment and trucks can be used to raise a dike provided the work is done well in advance of high river levels, however, heavy equipment is not generally advisable on a dike when the water level is near the crest due to vibration and saturation effects.

- Stripping large diameter vegetation from the dike crest when the water is at or above the freeboard level should be avoided if possible as you are loosening the very fill material that you are relying on. A better method would be to cut it as close to the crest elevation as possible and then place a thin layer of fill over it to allow access.

Alternative measures

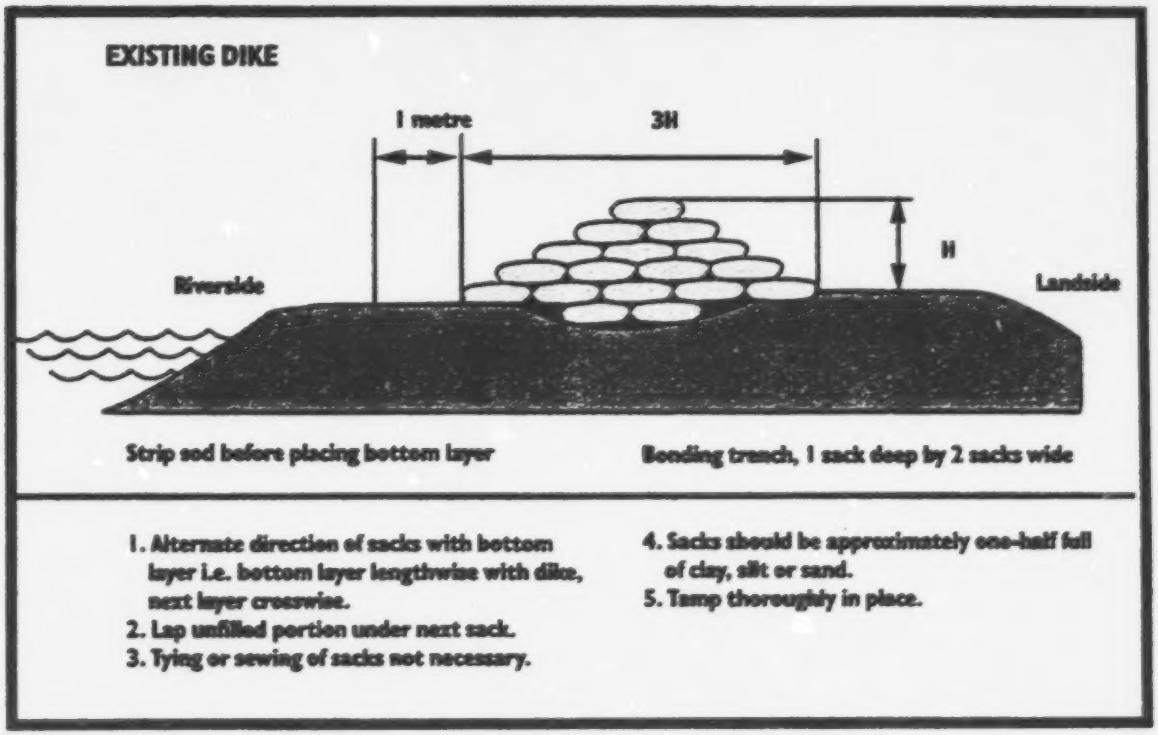
The Alberta publication *Alternatives to sandbags for temporary flood protection, 1998*, describes other methods that can replace sandbags as temporary flood protection measures.

The publication is essentially a review of available published literature and commercial brochures. Proposed new techniques and methods were critically evaluated based on common professional practice and gathered experiences in flood fighting. The systems can be considered as complementary means in flood protection and control. The use and effectiveness of each method is often situation dependent. Proper planning and preparation is always needed in order to achieve full efficiency

In addition, refer to the Flood Response Resource Listing for source information on using Aqua-Barrier, Aqua Dam, Flex-Mac, Gabions, Lock-Blocks and the Sandbagger for raising existing dikes.

Method for Sandbag Diking

Figure 2



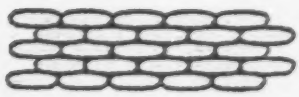
Strip sod before placing bottom layer

Bonding trench, 1 sack deep by 2 sacks wide

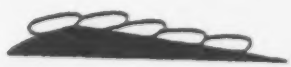
1. Alternate direction of sacks with bottom layer i.e. bottom layer lengthwise with dike, next layer crosswise.
2. Lap unfilled portion under next sack.
3. Tying or sewing of sacks not necessary.
4. Sacks should be approximately one-half full of clay, silt or sand.
5. Tamp thoroughly in place.

Bags Required for 30 Linear Metres of Dike

Height Above Dike	Bags Required
1/3 metre	800
2/3 metre	2000
1 metre	3400



PLAN OF BOTTOM LAYER

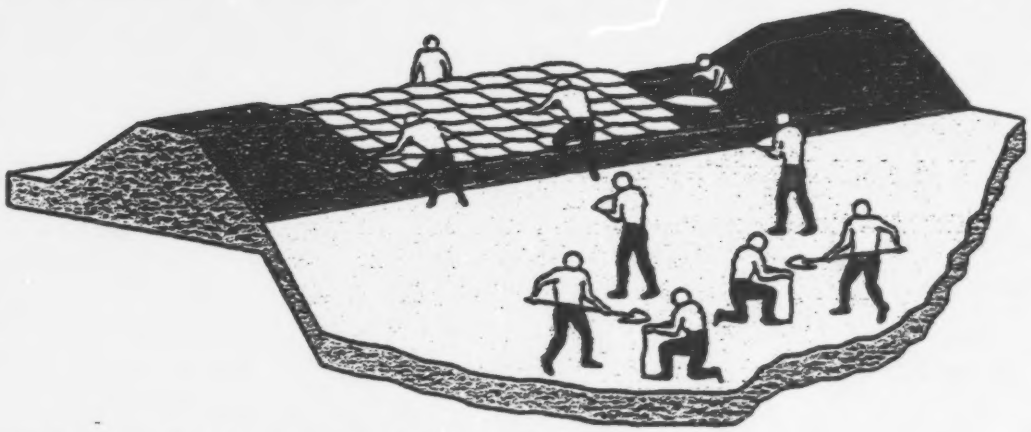


METHOD OF LAPPING SACKS

Emergency Works

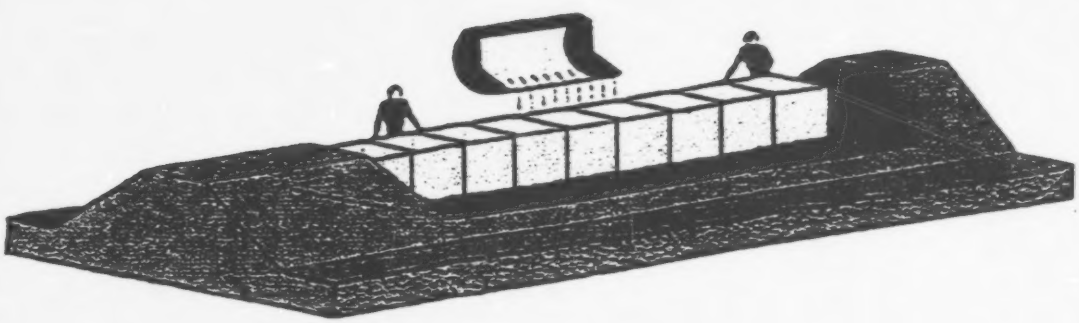
Figure 3

Classic Use of Sandbags



- High Labour Requirement (10-15 people)
- Long Time Requirement (approximately 8 hours)

Wire Baskets

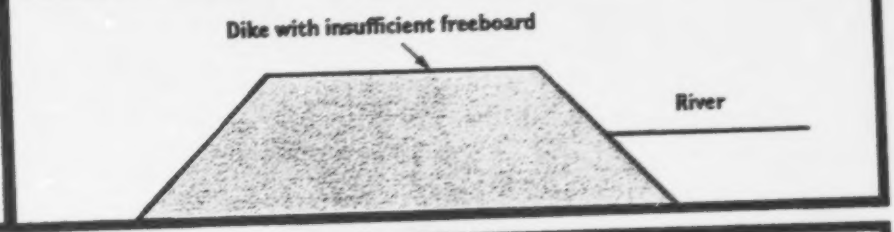


- Minimum Labour Requirement (2-3 people)
- Lowest Time of Installation (approximately 25 minutes)

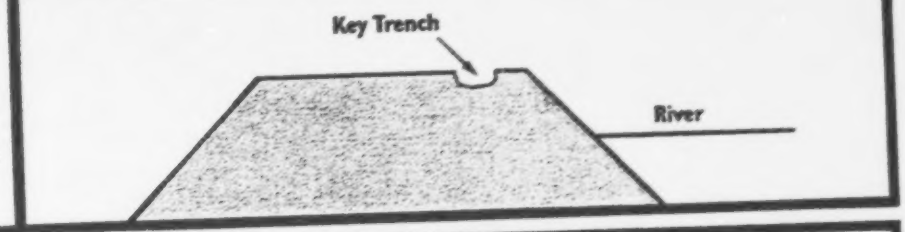
Windrow & Plastic Sheet Method

Figure 4

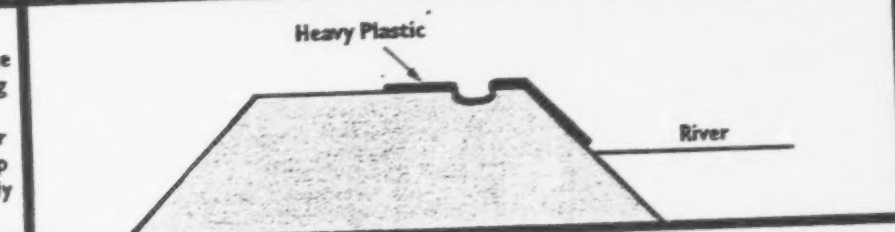
Step 1
Identify extent of problem area.



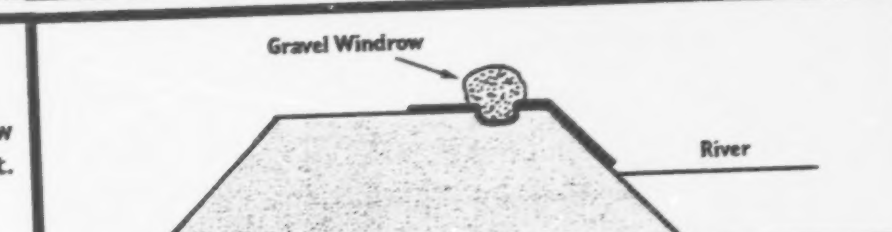
Step 2
Evacuate a shallow (0.15 metres plus) bonding (key) trench.



Step 3
Place plastic starting at the downstream end, ensuring that the majority of the sheet width is on the river side of the trench. Overlap roll ends by approximately five metres.



Step 4
Place fill in a windrow to the desired height.



Step 5
Fold the plastic over the windrow and hold it in place with the sandbags or fill.

NOTE: This method is restricted in height by the width of the plastic (usually 2.4 metres) and should therefore be used in places where the freeboard only has to be raised by 0.4 metres and less.

Landside Damage

Tips for Landside Damage

Excessive Slope Seepage

Where seepage on the dike landside slope leads to soggy unstable conditions, free draining fill berms may be needed. The berm should start and end at an appropriate safe distance both upstream and downstream of the seepage area.

Saturation Of Fills

If high water levels are sustained for some time and the dike fill becomes saturated, it may be necessary to restrict traffic on the dike crest road.

Active Boiling

The simplest and most effective method of treating an active boil (one that is carrying sand and silt) is to construct an impervious ring around it of a sufficient height to stop the transportation of solid material. It should not be built to a height which stops the flow of clear water because of the probability of building up an excessive local pressure head, which could cause dike failure or additional boils nearby. Concrete well rings, short pieces of large diameter pipe, earth berms, sheet steep pilings, etc., can all be used, but the most generally accepted method is using sandbag rings.

The recommended method of building a sandbag containment ring is as follows (See Figure 5):

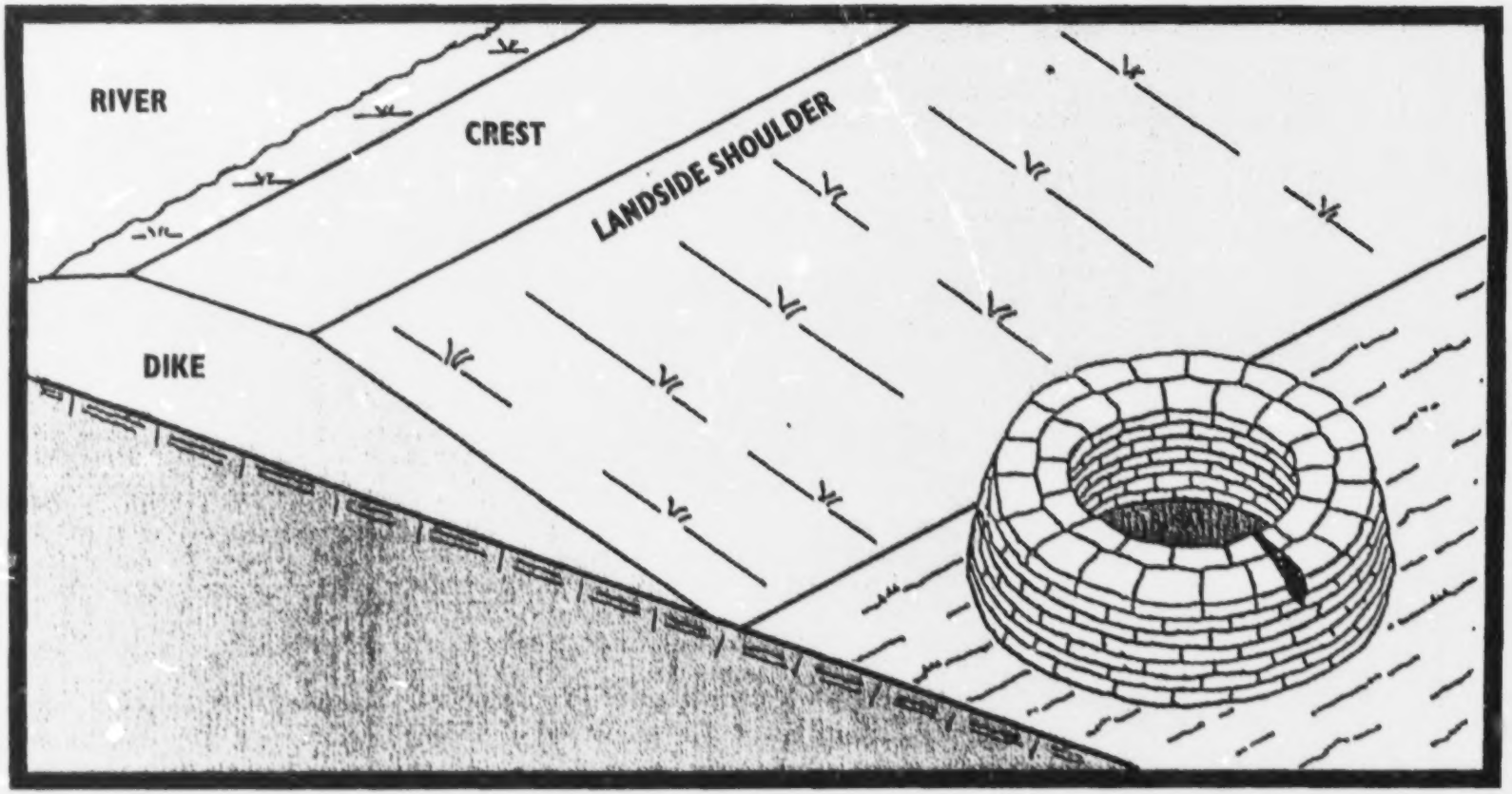
- Scarify the base for the ring (internal diameter of which should be at least 1.5 times the contemplated height) to provide a watertight bond between the natural ground and the sack ring (a very important step).
- Lay sacks in a ring around the boil and surrounding weak ground starting at its outer edge and working towards the center. Joints are staggered and loose earth is used as a mortar.
- When the proper height is reached (when clear water only is being discharged), a "V"-shaped drain constructed of wood or sheet metal should be inserted near the top of the ring to carry off the water in a more controlled manner in the most desirable direction.
- An alternative method of controlling an active boil is by placing a blanket of pea gravel or other free-draining gravel over it. The thickness of the gravel blanket must be increased until the seepage water runs clean. Note: When soil conditions are such that boils occur, it will probably be impossible or imprudent to bring loaded dump trucks into the area, even the

dike may be impossible for heavy vehicles. First consideration should be given to methods which do not impose heavy loads on the ground adjacent to the boils.

- All flowing inactive boils should be flagged and closely monitored throughout the flood period in case they start to transport solids.

Active Boiling

Figure 5



Flood Barrier Construction

Tips for Flood Barrier Construction

The construction of dikes can provide temporary protection against flooding. The construction of the barriers takes time; thus it is necessary to have an accurate flood forecast to prevent unnecessary expenditure of resources and to ensure that the barrier is constructed in time.

To obtain the most effective use of flood barriers, it is best to consider the following factors prior to construction.

1. Select the shortest practical route - saves time and resources.
2. Provide maximum protection. The dike location should offer protection to the greatest number of structures.
3. Take advantage of high ground.
4. Avoid sharp bends, unstable river banks.
5. Utilize the available floodplain mapping to determine the areas that are threatened, the shortest route, high ground, and the evacuation routes.
6. Keep trees and brush between dike and river. The trees and brush provide protection to the dikes from debris and ice.
7. Leave at least 2.5 metres between dike and buildings which will allow access to the dikes from the landward side.
8. Keep as far away from the river as possible.
9. If possible, discuss alignment with local floodplain management officials.

The following poor construction practice may also result in a dike failure: (1) joining a dike with a solid wall; (2) structures, trees or debris projecting from the riverside of the dike; (3) a pipe through the fill.

Sandbag Dike Construction

Sandbags may be used where a low short barrier is acceptable and earth fill is not practical. The construction of sandbag dikes are time consuming, expensive, and require a significant amount of manual labor. The following steps are recommended for the construction of a sandbag barrier (See Figure 6):

1. Remove all ice and snow, sod, down to bare ground, if possible.

2. Dig a bonding trench 2 sacks wide, 1 sack deep (0.6 m wide, 0.3 m deep). (If on a roadway this may have to be omitted.)

3. Lay a polyethylene seepage barrier across trench, there should be enough to cover the riverside of the sandbag. The riverward slope is covered with the polyethylene seepage barrier, protected with 1 layer of sandbags. Polyethylene should have slack to allow outer side bags to be taped into place and to avoid puncture. Anchor excess poly at top of dike using sandbags. Poly is not used on landward slope.

4. Fill trench with sandbags perpendicular to flood, bottom of bags toward the flood, unfilled portions toward building.

5. The bottom layer of sandbags is laid parallel to flow, with subsequent layers alternating (i.e., perpendicular, parallel, etc.) The base of the barrier should be about three times the height. It is advisable to not exceed 0.9 metre high.

When filling and placing the sandbags, the following suggestions should be used:
1. The sandbags should be filled with sand or sand and gravel.
2. Bags should be half (1/2) full.
3. Overlap unfilled portions with filled bag.
4. Tamp bags into place.
5. Need not tie bags.

Approximate materials needed for the construction of 30 lineal metres of dike:

Height	Bags	Sand Cubic Metres	Polyethylene Sheeting
0.3 metre	800	6	1.3 metres
0.6 metre	2000	16	1.5 metres
*1.0 metre	3400	28	1.8 metres

*Sandbag walls not recommended over 0.9 metres high.

Reference: *Michigan Flood Hazard Mitigation Handbook, 1988*

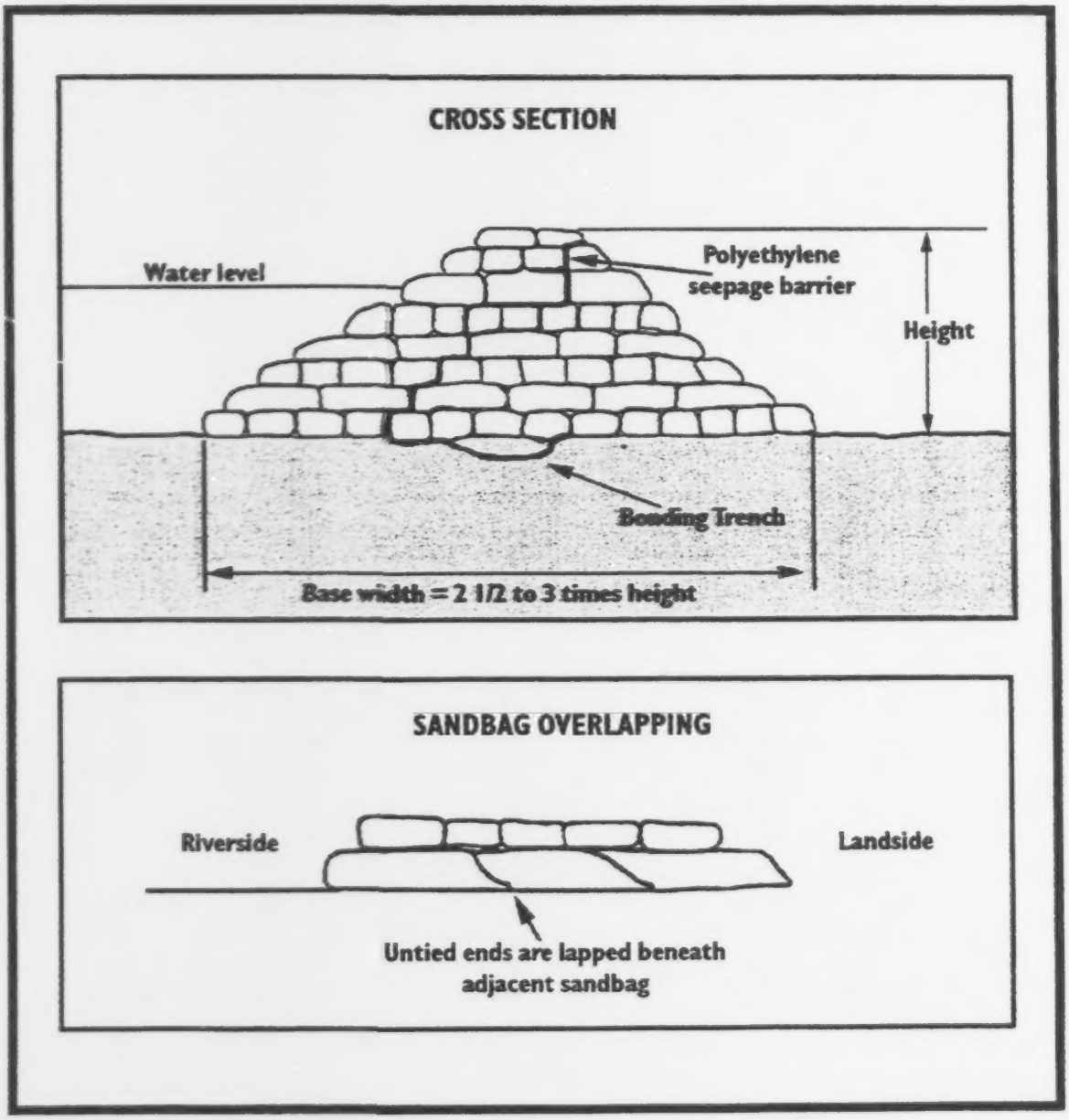
Alternative measures

The publication *Alternatives to sandbags for temporary flood protection*, Alberta Disaster Services, 1998, describes alternative methods that can replace sandbags as temporary flood protection measures.

The publication is essentially a review of available published literature and commercial brochures. Proposed new techniques and methods were critically evaluated based on common professional practice and gathered experiences in flood fighting. The systems can be considered as complementary means in flood protection and control. The use and effectiveness of each method is often situation dependent. Proper planning and preparation is always needed in order to achieve full efficiency.

Sandbag Dike Construction

Figure 6



Slope Protection Of Earth Fill Dikes

The construction of dike for flood protection may subject the slopes to scour, debris damage, seepage, and possibly wave action. Thus it is necessary to provide protection to the slope to prevent a failure of the dike. Under emergency conditions it is generally not possible to provide permanent slope protection. The use of a combination of polyethylene and sandbags has proven to be an effective protection method, provided the placement is done correctly.

Anchorage of the Polyethylene (Poly)

For the polyethylene to provide adequate protection of the slope, it must be properly anchored at the toe and on the slope. To anchor the toe of the polyethylene there are several methods that could be used:

1. Excavate a trench and place the poly in the trench and backfill.

2. Poly may be placed away from the toe, and stabilized with fill.

3. Place the poly away from the toe and stabilize with sandbags. Poly is not really necessary on clay embankments if stream velocities are less than two feet per second.

The poly should be started at the downstream end and placed with at least 0.6 metre of overlap. The poly is held down by sandbags. A solid "blanket" of sandbags should be used when high velocities, heavy debris, or ice may occur; if not anticipated, a grid system can be used. The grid system can include sandbags, 2" × 4" lumber and sandbags, or rope and sandbags.

The critical areas of an embankment should receive priority when placing poly. Poly should not be placed on the landward side of the embankment. If done, seepage may be forced elsewhere and result in failure.

Riprap may be used to control high erosive or impact forces. However, this is a very costly method which requires a large amount of material that may not be readily available.

Other forms of slope protection include groins to deflect the current, log booms to deflect debris, and straw bales to reduce wave action.

Flashboard Dike

A flashboard dike is constructed using lumber and earth fill. 2" × 4" posts are driven at least 0.6 metres into the ground, located on about 1.3 m to 1.8 m centers. 1" × 12" boards are placed horizontal between the post. An earth berm is placed landward of the flashboards, and is tamped against the bottom board. The berm has a minimum 0.6 m top width, and a 1 on 2 slope on the landward side of the berm (See Figure 7).

Box Dike

A box dike consists of two rows of 2" × 2" (or 4" × 4") posts driven at least 0.6 metres into the ground, located on about 1.3 m to 1.8 m centers parallel to flow. The parallel rows of posts are driven on a spacing of about 2 times the height of the box. (If box is 1.3 metres high, the rows of post are driven 2.6 metres apart). 1" × 12" boarding is placed horizontally inside of the posts to contain the earth fill, and 2" × 4" bracing is provided to hold posts in place (See Figure 8).

These types of dikes are very costly and require a considerable amount of time to construct. Thus, they are generally not used, unless the area is very restrictive and earth fill dikes will not work

Reference: *Michigan Flood Hazard Mitigation Handbook, 1988*

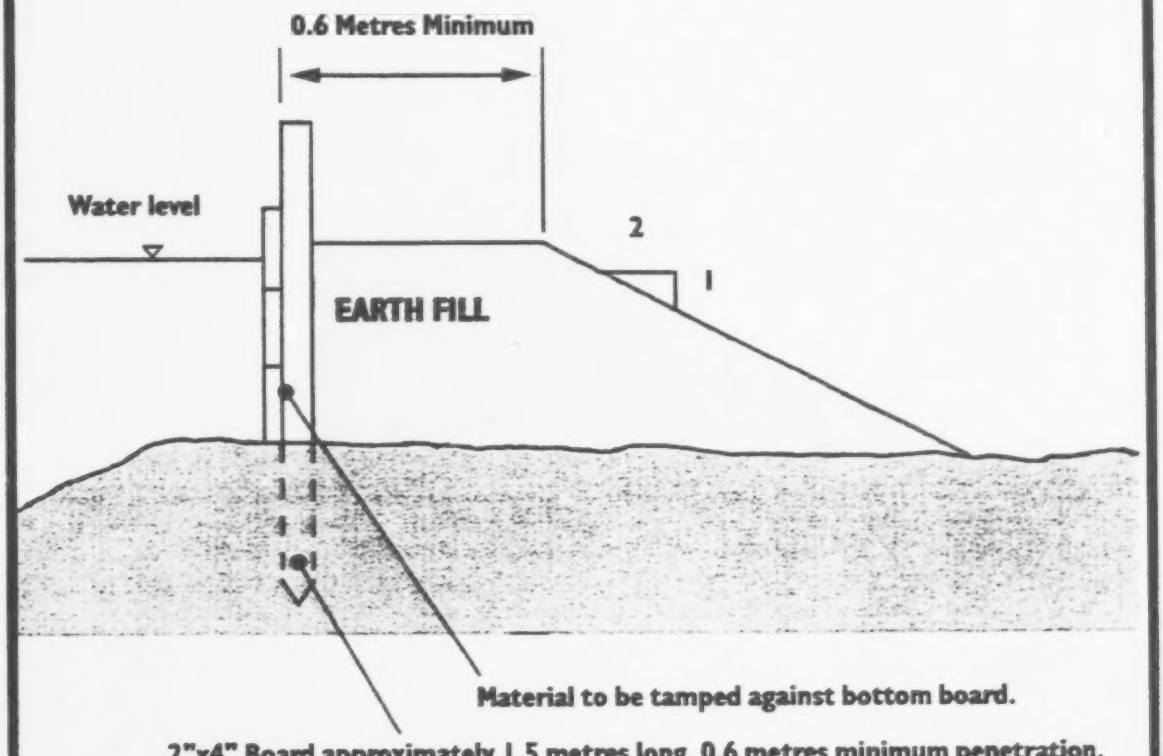
Other Flood Barrier Construction Methods

Refer to the Flood Response Resource Listing for source information on using Aqua-Barrier, Aqua Dam, Flex-Mac, Gabions, Lock-Blocks and the Sandbagger for constructing flood barriers.

Flashboard Dike

Figure 7

A flashboard dike is constructed using lumber and earth fill. 2"x4" posts are driven at least 0.6 metres into the ground, located on about 1.2 metre to 1.8 metre centers. 1"x12" boards are placed horizontal between the posts. An earth berm is placed landward of the flashboards and is tamped against the bottom board. The berm has a minimum 0.6 metre top width, and a one on two slope on the landward side of the berm.



Box Dike

Figure 8

A box dike consists of two rows of 2"x2" (or 4"x4") posts driven at least 0.6 metres into the ground, located on about 1.2 to 1.8 metre centers parallel to flow. The parallel rows of posts are driven on a spacing of about two times the height of the box. (If the box is 1.3 metres high, the rows of post are driven 2.6 metres apart). 1"x12" boarding is placed horizontally inside the posts to contain the earth fill, and 2"x4" bracing is provided to hold the posts in place.

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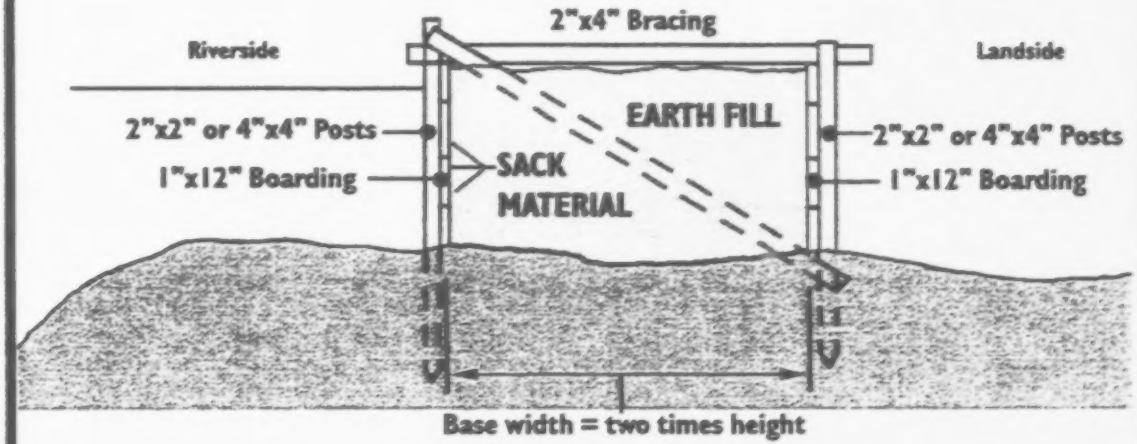


Riverside Damage

Tips for Riverside Erosion

- identify problem areas
- use soundings to determine 'condition' of toes of slopes (Fraser River)
- assemble stockpiles of armor material
- 'as builts' for 'structures'
- consider restriction/speed limits for boat traffic
- follow MELP/DFO guidelines for works/maintenance - instream works - response protective flood work
- where river currents are eroding the face of the dike or nearby overbank, additional large rock riprap should be placed with an excavator or end dumped provided the site is accessible and safe for heavy equipment to operate.
- in some circumstances (access is hampered or the available material is too small to be placed directly into the water) placing the fill in a setback arrangement may have advantages.

Emergency Placement Of Riprap

Effective placement of riprap during flood response conditions is one of the most difficult construction tasks you can encounter. Methods depend to a great extent on site specific conditions. However, there are usually two factors that weave a common thread. They are:

1. riprap is usually considered when the erosion is already causing problems
2. riprap delivery rate is, at least initially, never fast enough.

Riprap placement should always be done with a hydraulic excavator of sufficient size (preferably equipped with a hydraulic thumb) to handle the largest riprap that can be delivered. Dumping straight from the tandem into the water, is usually a waste of valuable resources. The rock not only tends to segregate itself into sizes in the dumping process, but the buoyancy effect of the water often leads to the rock being carried downstream. Once it does reach bottom the current can continue to carry it great distances. I have seen I metre diameter rock carried several metres before it even touches the stream bed. The advantage of the hydraulic excavator is that it can hold the rock till it reaches the stream bed or in cases where the depth exceeds the combined

reach of the boom and slick, at least a much lower elevation is achieved before the rock is released (thus reducing the distance traveled).

When starting an emergency riprap job, the first thing to do is look for a hard point or any area that due to the present bank alignment or position of natural obstacles such as roots or stumps, offers a pocket of slower current. Riprap placed here has the best chance of remaining. This foothold, can often be added to, both upstream and downstream. If no such pocket exists, another method of establishing a foothold must be found. Near Hixon, a car body was held submerged by the excavator till rock was placed in the area of reduced water velocity immediately downstream. From this established hard point riprap was then added both upstream and downstream. I have heard of concrete pipeline anchors being used in a similar manner.

Once a hard point has been established it is often worth considering extending it out into the current to act as a short groyne, deflecting some of the current away from the bank. However, an onsite decision must be made to determines if the rock lost to the current in its construction, would not provide more benefit if placed lineally along the bank.

Another danger to look out for is outflanking. Your hard point will become useless if the ground upstream of it is eroding . For this reason, we recommend that one of the first things to be done is the digging of a key trench, This is simply a 45 degree (facing downstream) trench dug down into the bank as far as possible (remember the ground will the saturated) . Its width depends on the height of the trench but is never less that 4 metres wide and is filled with the biggest rock you can obtain. If the bank continues to erode upstream of this trench, its angle tends to defect the current back to the river.

As mentioned above, it is often the case of too little too late that causes most of the problems. We have taken the view that in riprapped areas that have a history of being damaged during flooding, riprap stockpiling goes a long way to lessen the danger. The advantages are great. Only one machine, the excavator is needed freeing other equipment to work on other sites. The erosion area can quickly be repaired before it becomes a major problem. No more agonizing hours of waiting for the rock to arrive, watching the situation deteriorate.

Ice Jams

Tips on Ice Jam Flooding

Ice jam flooding is usually sudden, generally unpredictable, and sometimes severe. It can happen in most of British Columbia except for the lower mainland and Vancouver Island and during freeze-up and winter and spring breakups.
Certain locations on certain streams have a history of ice jamming, and these locations, if populated, deserve special precautionary measures, and, perhaps, post-event actions by local flood response agencies if ice jamming potential is high or ice jams occur.

Some of the possible mitigative actions, both pre- and post-event, may have adverse environmental or human impacts so controversial courses of action must be clearly understood and risks accepted by decision makers.

Ice jams are dangerous to work on or around due to their temporary nature. Safety of personnel overrides need to remove a jam in nearly all instances.

Possible pre-jam steps to reduce jamming potential damage:

- Stay in daily contact with area heavy construction firms and know whereabouts of all useful equipment, particularly excavators, and transport trucks. Have 24-hour means of contact with primary and secondary staff of each firm and MOTH staff, if local.
- Consider ice cover weakening techniques such as cutting, blasting, machine removal or breaking of ice, surface treatment (this is either dusting with dark substance or pumping bed material onto ice cover from streambed in silt or sand bed rivers)and removal of snow cover on ice cover to hasten melting. These techniques must be done at the right time to be effective (and safe).
- Use empirical methods to forecast the onset of potentially severe breakups or freeze-ups.
- Have one or more upstream observers report breakup or severe freeze-up conditions at their locations as soon as it occurs.
- Theoretically, aerial bombing could be used, but this has huge liability risks in populated areas, particularly on small streams, and the nearest air force base is in Edmonton.
- Another possible beneficial measure on regulated rivers is to manipulate storage releases during critical breakup or freeze-up periods.
- When the potential for ice jam flooding is high, media should be kept updated as the situation develops. People should be warned to remove personal possessions, including pets and farm animals, from low-lying areas in threatened reaches.

Possible post-jam steps to mitigate damage:

- Monitor upstream river situation for river flow, other jams (and what actions upstream communities may be taking to release them), and concentrations of running ice.
- Get best weather forecast information available and closely monitor jam water levels.
- Consider blasting or mechanical removal of jammed ice in light of environmental and human hazards both at the site and downstream. If removal is successful, you do not want to cause an even bigger problem downstream if the surge of ice worsens a jam downstream.
- Blasting and mechanical removal will usually only be successful if done soon after jam forms and there is open water downstream for the jammed ice to get away; otherwise, you may simply thicken the jam causing even higher water levels.
- Blasting also requires that there is a good flow of water beneath the jam and that there is a lookout upstream with reliable instant communication device to warn blasters on the ice in case of jam movement. The same lookout is required if equipment working in the channel itself.
- The *New Brunswick River Ice Manual (Section 6.1.5)* advises that "Blasting ice jams is rarely effective and is dangerous to the blasting crew and neighbouring property. The placement of an explosive charge is dangerous work that must only be performed by trained personnel. Adequate safety, rescue and first aid measures should be in place before the commencement of work."

River Ice Investigation Report

File: 76855-08\Ice Jams

BACKGROUND

Date: _____ Time: _____

River / Creek Name: _____

☐ Regular Inspection

Or. . .

☐ Complaint By: Name: _____

Address: _____

Location: _____

_____ GPS: N W

GENERAL COMMENTS

Ambient Temperature: _____ Degrees C / F

Water Temperature: _____ Degrees C / F

Evaluation (re: Bank height) _____ metres / feet

Existing Water Elevation: _____ metres / feet

Est. backwater Elevation: _____ metres / feet

Open Channel Flow: Y / N Estimated Velocity: _____ metres per second / feet per second

ICE CONDITIONS

☐ Frazil Ice

☐ Shelf Ice

☐ Anchor Ice

☐ Pack Ice Shear Lines: Y / N

Ice Movement: Y / N

Comments: _____

_____

_____

Report: Written By: _____

Date Written: _____

Debris Flows

Tips On Debris Flows And Mudflows

Debris flows and mudflows usually strike without warning. The force of rocks, soil, or other debris moving down a slope can devastate anything in its path. Take the following steps to be ready:

Before
Get a ground assessment of your property.

Your local planning department may have specific information on areas vulnerable to debris flows. Consult a professional geotechnical expert for opinions and advice on debris flow problems and on corrective measures you can take.

Minimize home hazards:

- Plant ground cover on slopes and build retaining walls.
- In mudflow areas, build channels or deflection walls to direct the flow around buildings.
- Remember: If you build walls to divert debris flows and the flow lands on a neighbor's property, you may be liable for damages.
- The ground slopes downward in one specific direction and may begin shifting in that direction under your feet.

Make evacuation plans.
Plan at least two evacuation routes since roads may become blocked or closed.

Develop an emergency communication plan.
In case family members are separated from one another during a debris flow or mudflow (this is a real possibility during the day when adults are at work and children are at school), have a plan for getting back together.

Ask an out-of-province relative or friend to serve as the "family contact." After a disaster, it's often easier to call long distance. Make sure everyone knows the name, address, and phone number of the contact person.

During

If inside a building:

- Stay inside.
- Take cover under a desk, table, or other piece of sturdy furniture.

If outdoors:

- Try to get out of the path of the debris flow or mudflow.
- Run to the nearest high ground in a direction *away* from the path.
- If rocks and other debris are approaching, run for the nearest shelter such as a group of trees or a building.
- If escape is not possible, curl into a tight ball and protect your head.

After

Stay away from the slide area.
There may be danger of additional slides.

Check for injured and trapped persons near the slide area.
Give first aid if trained.

Remember to help your neighbors who may require special assistance - infants, elderly people, and people with disabilities.

Listen to a battery-operated radio or television for the latest emergency information.
Remember that flooding may occur after a mudflow or a debris flow.

Check for damaged utility lines.
Report any damage to the utility company.

Check the building foundation, chimney, and surrounding land for damage.

Replant damaged ground as soon as possible since erosion caused by loss of ground cover can lead to flash flooding.

Seek the advice of a geotechnical expert for evaluating debris flow hazards or designing corrective techniques to reduce debris flow risk.

Reference: (US) Federal Emergency Management Agency

Tsunamis

Tips on Tsunamis

A tsunami is a series of waves that may be dangerous and destructive. When you hear a tsunami warning, move at once to higher ground and stay there until local authorities say it is safe to return home.

Before

Find out if your home is in a danger area.
Know the height of your street above sea level and the distance of your street from the coast. Evacuation orders may be based on these numbers.

Be familiar with the tsunami warning signs.
Because tsunamis can be caused by an underwater disturbance or an earthquake, people living along the coast should consider an earthquake or a sizable ground rumbling as a warning signal. A noticeable rapid rise or fall in coastal waters is also a sign that a tsunami is approaching.

Make sure all family members know how to respond to tsunami.

Make evacuation plans.
Pick an inland location that is elevated. After an earthquake or other natural disaster, roads in and out of the vicinity may be blocked, so pick more than one evacuation route.

Teach family members how and when to turn off gas, electricity, and water.

Teach children how and when to call 9-1-1, police or fire department, and which radio station to listen to for official information.

Have disaster supplies on hand.
- Flashlight and extra batteries
- Portable, batter-operated radio and extra batteries
- First aid kit and manual
- Emergency food and water
- Nonelectric can opener
- Essential medicines
- Cash and credit cards
- Sturdy shoes

Develop an emergency communication plan.
In case family members are separated from one another during a tsunami (a real possibility during the day when adults are at work and children are at school), have a plan for getting back together.

Ask an out-of-province relative or friend to serve as the "family contact". After a disaster, it's often easier to call long distance. Make sure everyone knows the name, address, and phone number of the contact person.

During

Listen to a radio or television to get the latest emergency information, and be ready to evacuate if asked to do so .
If you hear an official tsunami warning or detect signs of a tsunami, evacuate at once. Climb to higher ground. A tsunami warning is issued when authorities are certain that a tsunami threat exists.

Stay away from the beach.
Never go down to the beach to watch a tsunami come in. If you can see the wave, you are too close to escape it.

Return home only after authorities advise it is safe to do so.
A tsunami is a series of waves. Do not assume that one wave means that the danger is over. The next wave may be larger than the first one. Stay out of the area.

After

Stay tuned to a batter-operated radio for the latest emergency information.

Help injured or trapped persons.
Give first aid where appropriate. Do not move seriously injured persons unless they are in immediate danger of further injury. Call for help.

Remember to help your neighbors who may require special assistance - infants, elderly people, and people with disabilities.

Stay out of damaged buildings. Return home only when authorities say it is safe.

Enter home with caution.
Use a flashlight when entering damaged buildings. check for electrical shorts and live wires. Do not use any appliances or lights until an electrician has checked the electrical system.

Open windows and doors to help dry the building.

Shovel mud while it is still moist to give walls and floors an opportunity to dry.

Check food supplies and test drinking water.
Fresh food that has come in contact with flood waters may be contaminated and should be thrown out. have tap water tested by the local health department.

Inspecting Utilities in a Damaged Home
Check for gas leaks - If you smell gas or hear a blowing or hissing noise, open a window and quickly leave the building. Turn off the gas at the outside main valve if you can call the gas company from a neighbor's home. If you turn off the gas for any reason, it must be turned back on by a professional.

Look for electrical system damage - If you see sparks, broken or frayed wires, or if you smell hot insulation, turn off the electricity at the main fuse box or circuit breaker. If you have to step in water to get to the fuse box or circuit breaker, call an electrician first for advice.

Check for sewage and water line damage - If you suspect sewage lines are damaged, avoid using the toilets and call a plumber. If water pipes are damaged, contact the water company and avoid using water from the tap. You can obtain safe water by melting ice cubes.

Reference: (US) Federal Emergency Management Agency

Dam Safety

Tips on Dam Safety

- identify all dams which could impact the Local Authority/Diking Authority area
-
- identify dam owners and ensure that they have developed a Dam Safety Program
-
- integrate these Dam Safety Programs into the Local Authority/ Diking Authority flood response plan

What is a Dam?
Simply stated, a dam is a man made barrier constructed for the purpose of storing water.

The two most common types of dams constructed around the world are embankment dams and concrete dams. The majority of the approximately 2600 dams constructed in British Columbia are earthfill embankment dams.

A dam consists of a variety of different components, each having its own unique potential problem area and inspection requirement. The main components that make up a dam include: earth or concrete barrier, abutments, foundation, outlet, spillway and gates.

Why should a Dam Owner have a Dam Safety Program?
Dams, by their very nature, create risks. Although these risks may be minimal they can increase substantially without proper maintenance. Many subtle signs which can be symptomatic of larger problems may go undetected for a variety of reasons.

Sooner or later these problems will become apparent even to the untrained eye. However, by the time a problem has progressed to this point, potential risk has greatly increased and repairs can become complex and extremely expensive. In most situations a Dam Safety Program that includes regular preventative maintenance, routine visual inspections, and the identification of problems in their early stages will ensure that the dam remains in good operating condition.

By having a Dam Safety Program, for even the smallest dams, the owner benefits by:

- **protecting his/her investment**
- **being able to recognize problems in their early stages and eliminate them before they become complex and expensive**
- **minimizing risks to others and potential liability in case of failure**
- **having a secure source of water**
- **conserving a valuable resource, namely water**

Who is Responsible for Dam Safety?

In all cases, dam owners are clearly responsible for the safe operation and maintenance of their dams. English common law, on which our legal system is based, considers dams to be inherently dangerous structures and those who own dams are liable for any damages that are caused by them.

The Water Act of British Columbia requires that a water licence be issued if water is to be stored and works constructed. The registered licensee, be it a private individual or a corporation thus becomes the 'dam owner'. Section 21 (1) of the Water Act states:

> "A licensee, holder of an approval or person who makes a change in and about a stream in accordance with the regulations must
>
> (a) exercise reasonable care to avoid damaging land, works, trees or other property, and
>
> (b) make full compensation to the owners for damage or loss resulting from construction, maintenance, use, operation or failure of the works."

Or in other words, the dam owner- is responsible for ensuring that their dam and appurtenant works are structurally sound, operated safely and maintained adequately to prevent loss of life, damage to the environment, or adverse social impact such as loss of communal water supply or infrastructure from a dam failure.

What is Expected of the Dam Owner?

The dam owner's expected actions include:

- thorough visual inspections, accurate monitoring when required-
- recording and interpreting information gained from inspection and monitoring;
- regularly scheduled routine maintenance;
- making required repairs in a timely manner;
- preparing Operation, Maintenance & Surveillance plans and manual when required;
- preparing Emergency Preparedness plans when required; and
- operating the dam in a way that will give the greatest assurance of safety.

The required intensity of effort will vary in relation to the loss that would be experienced in terms of loss of life, the downstream development, and the value of the structure itself.

Reference: *MELP Dam Safety Guidelines, 1998*

Internal Drainage

Internal Drainage Tips

Temporary pumping may be required to remove the accumulation of snowmelt, rainfall, or seepage behind the barriers. Since the amount of pumping required is site specific it is not possible to give a rule of thumb. The pump size is dependent upon:

1. The drainage area being "cut-off" by the barrier
2. The amount of seepage through and beneath the barriers
3. Amount of storm sewer infiltration and back-up
4. The amount of ponding allowed before damage will occur.

It may be necessary to pump the sewer system to keep it functioning. For sanitary sewage pumping, the pump size needed could be estimated by allowing 100 gallons per day, per person, and infiltration of 15,000 gallons per mile of sewer, per day. For a town with 4000 people and 25 miles of sewer, the pump capacity would be estimated by:

4000 people × 100 gallon/person/day =	400,000 gallon/day
15,000 gallons/mile/day × 25 =	375,000 gallon/day
Total Pump Capacity =	775,000 gallon/day or 538 gallon/minute

Suggest using one 4-inch centrifugal pump or equivalent

Storm And Sanitary Sewers Tips

If pumps are not able (or not available) to keep up with the overflow of manholes it is possible to ring the manhole with sandbags. Due to the high pressures that could result, it is not recommended to build the ring dike above the river elevation. It is suggested that the round be built part way and dispose of the leakage. As an alternative to sandbags, concrete "ring dikes" may be used. Manhole covers should not be attempted to be weighted down by sandbags, if high heads may occur.

Prevention Of Sewer Backup

During flood stages, water may "back up" through the sewer outfalls and cause flooding of basements and low lying areas.

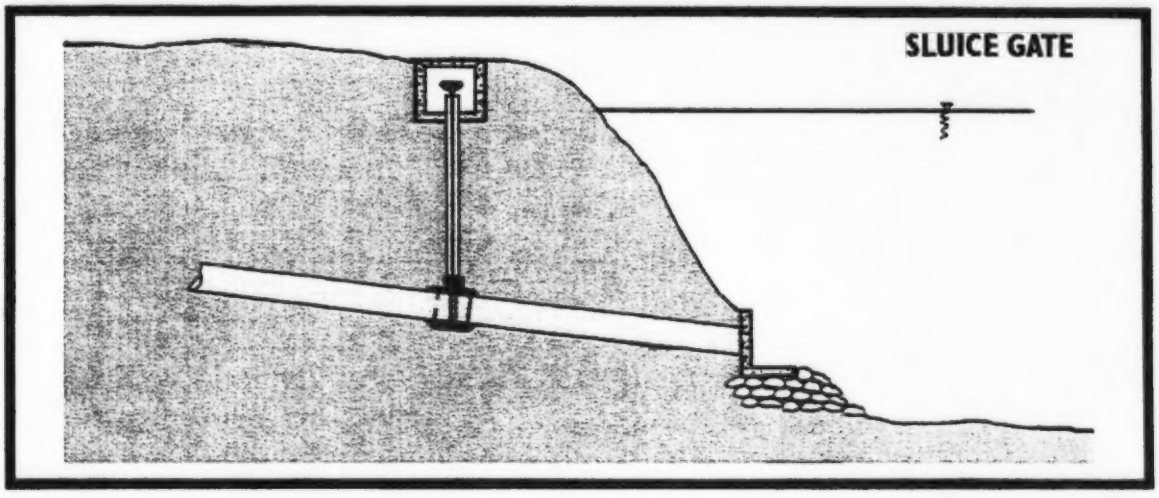
The methods of preventing sewer back up include (See Figure 9):

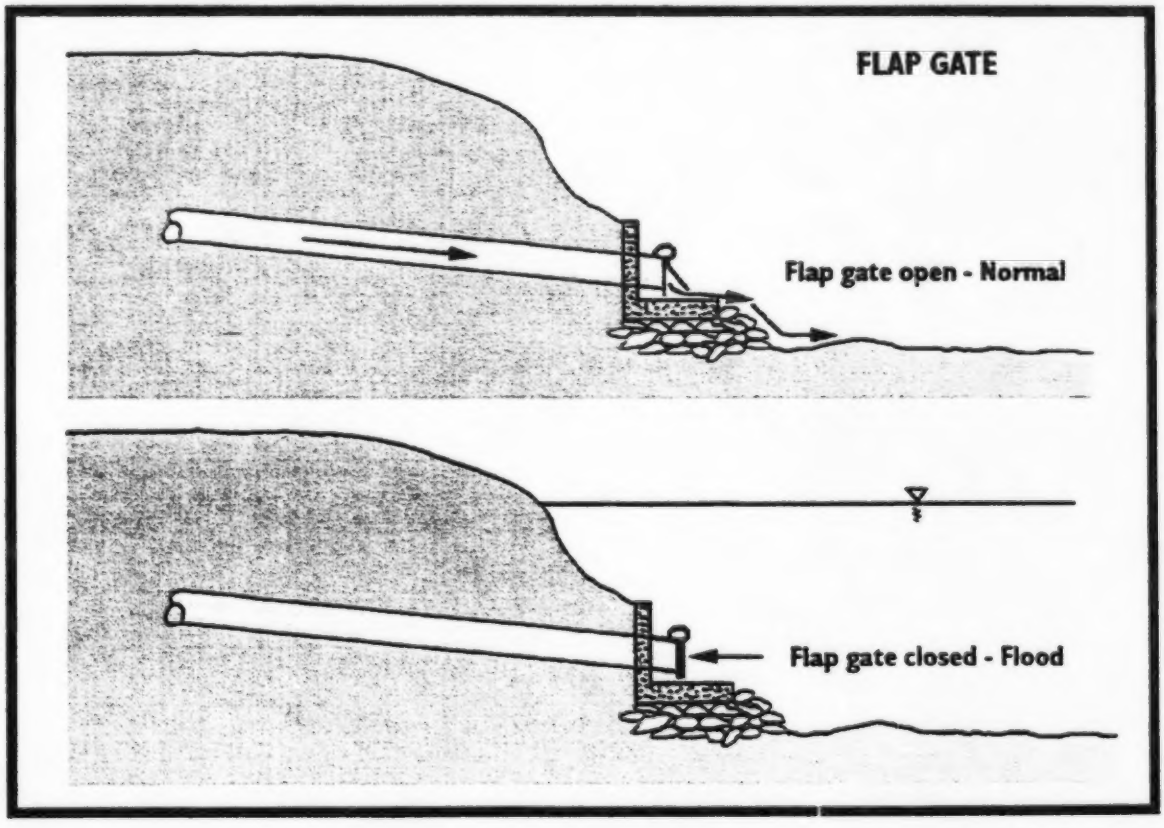
1. Sluice gates are generally closed manually, and are less likely to be blocked by debris than flap gates.
2. Flap gates close automatically if the river stage exceeds the stage on the sewer system. There is a potential problem that the gate may be propped open or blocked by debris.
3. Plugs are available which are inserted into the sewer pipe. Under emergency conditions, lumber, sandbags, and polyethylene can be used as a seal, placed on the outfall pipe. There are also manufactured pipe stoppers available.

Reference: *Michigan Flood Hazard Mitigation Handbook, 1988*

Methods of Preventing Storm-Sewer Backup

Figure 9





Roads and Bridges

Tips on Roads and Bridges

- identify and map vulnerable roads and bridges
- identify possible/historical erosion areas
- identify evacuation/disaster routes and the protection of key routes
- monitor changing conditions within the watershed
- carry out pre flood inspections

References

Emergency Response Plan - 1992
Ministry of Transportation and Highways
Describes emergency services delivered by MOTH personnel.

Round IV (1995-6) Maintenance Services Manual
Standards for Road and Bridge maintenance Services
(Maintenance Standards)
August 31, 1995
Ministry of Transportation and Highways
Describes emergency services delivered by MOTH maintenance contractors.

Flood Response Resource Listing

The following is a listing of resources that are known to the authors and has been included for information and possible inclusion in the local flood response plan at the discretion of the Local Authority/Diking Authority.

Inclusion here is not an endorsement of services or products.

The references listed below will have to be contacted to determine the availability and cost of the resources. The resources will have to be arranged well in advance of expected flooding since availability, delivery and possibly training must be considered.

Please add other resources that come to your attention to the listing and advise us by forwarding the Write Us! sheet found in PART 1 - FLOOD PLANNING, so that we may share the information with other Local Authorities and Diking Authorities.

Resources Listing

Diking and Flood Barrier Information

Aqua-Barrier™ Inc.
Phone: 800-245-0199
Sales Information: sales@aquabarrier.com
Flood Barriers, Spill Containment and Construction Dewatering.

Aqua Barrier Flood Fighting System
Geodesign AB
Teknikringen 1
583 30 LinkOping
Sweden
Phone: +46 13 211955 Fax: +46 13 211958
Email: Kullberg@geodesign.se
A water barrier using standard pallets, a metal support and a waterproof geomembrane.

Aqua Dam and Diversion Ltd.
6970 - 10th Avenue S. E.
Salmon Arm, BC V1E 4M3
Phone/Fax: 250-832-1332
A water barrier using portable water filled tubes.

Flex-Mac®
Maccaferri Gabions Of Canada Ltd.
736 Granville Street
Vancouver, BC V6Z 1G3
Phone: 604-683-4824 Fax: 604-683-7089
The Multicellular Structure for Emergency Works.

Gabions
Maccaferri Gabions Of Canada Ltd.
736 Granville Street
Vancouver, BC V6Z 1G3
Phone: 604-683-4824 Fax: 604-683-7089
Wire baskets filled with granular material.

Lock-Blocks
Innomech Manufacturing Ltd.
12600 Mitchell Road
Richmond, BC V6V 1M8
Phone: 604-325-9161
Pre-cast Concrete Retaining Wall Systems.

The Sandbagger Company of Canada Inc.
Box 500, No, 11 PR 241
St Eustache, Manitoba, Canada R0H 1H0
Phone: 204-353-2540 Fax: 204-353-2733
Manufacturer and Distributor of Sandbag Filling Equipment.

Sanilogical Projects
2001 River Drive
New Westminster, BC V3M 4V8
Phone: 604-524-3458 Fax: 604-524-4058
Ideas for alternative flood barrier construction methods.

Pump Information

ITT Flygt Canada
74 Glacier Road
Coquitlam, B.C. V3K 5Y9
Phone: 604 941-6664 Fax: 604 941-365